

Developments in the Concrete Products Industry During 1926

Block and Tile Production Increase During 1926 Is Over a Million—Sales and Merchandising Tendencies Are Most Significant Development of Past Year—Block Manufacturers Consolidate to Secure Production and Merchandising Advantages—Many Products Manufacturers Sell Block in the Wall—Production of Concrete Products Specialties Increases—1926 Has Been a Year of Awakening to Need of Aggressive Selling

IN 1926 the concrete products industry produced block and tile that totaled 705,000,000 in terms of 8x8x16 block, and that had a sales value of \$140,000,000. This is a very appreciable increase over the 600,000,000 block produced in 1925.

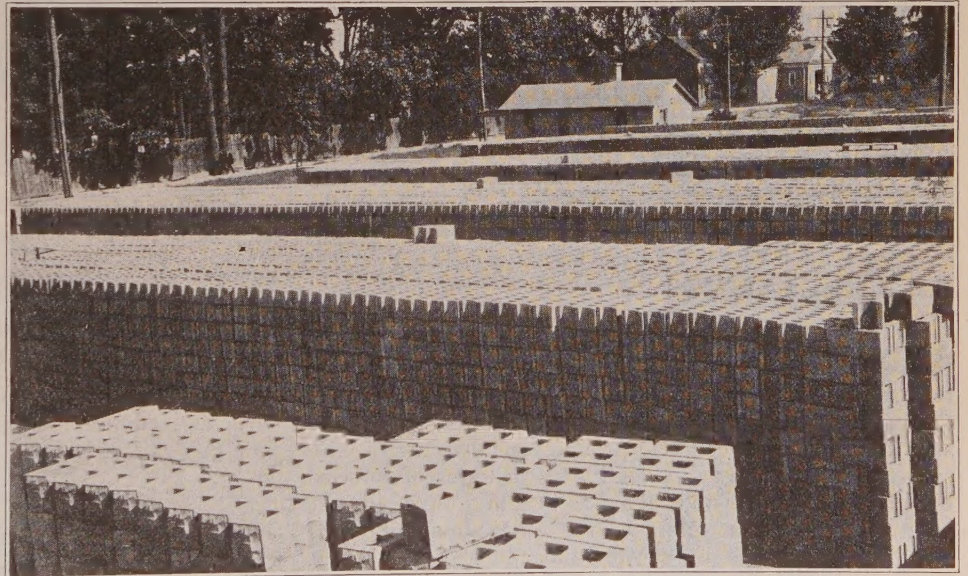
Along with this increase in output there were a number of very definite tendencies developed, and these, perhaps,

which is necessary to continue the increase of output which has been the mark of this industry for a good many years. The individual block makers in all parts of the country are beginning to realize that they can do more than simply make a good block and wait for someone to buy it. Most of the significant developments of the year were but the elaboration of this idea of more aggressive merchandising.

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Merchandising methods will put the block from many stock piles into the walls of buildings.

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are more important to the future of the industry than the mere fact that it increased its production a hundred million blocks in the past year.

The most significant—the parent and controlling cause of all the other noticeable tendencies—is the very definite trend among all branches of the products industry to cease to be simply order takers and to go out after the business

Production Advances

There has been a definite movement for instance to make a block which could be sold at a better price differential and still show a fair profit to the producer. One of the things which has been done to this end is the adoption of lighter weight units in preference to old standard 8x8x16 blocks. The standard block has many uses and has many

advantages, but products manufacturers are beginning to appreciate the fact that a scientifically designed unit which will deliver equivalent strengths with the use of a lesser volume of cement can be sold at a better profit per pound of concrete involved.

It is also beginning to be appreciated that larger plants, higher production, and the greater division of labor which goes with such increase in production capacity, make it possible to produce blocks more economically and to sell them at a lower margin of profit. This is not true in all instances, of course, for the small producer can very often make the same economies that the larger producer does. But it is true in a great many instances where smaller producers are not on their toes as they should be. It is accordingly not surprising to see consolidation of plants in a given locality, and the interest being manifested in the industry by capitalists who are seeking fields for investment where such consolidations or increases of plant size are apt to yield reasonably large returns. The recent consolidation of a group of plants in the Pittsburgh district is a very striking example of the way in which this thing works out.

Specialties as Side Lines

The average owner of a small plant who has no intention of consolidating with anybody is feeling this same competitive pressure, and he is beginning to look around and see what steps he can take to combat this. In order to increase his output and reduce the amount of overhead on each unit produced he is in many instances considering the manufacture of various concrete specialties. The result has been a great development of such branches of the industry as the concrete burial vault business, the septic tank business, and the trim stone business. Items of this kind can be added to the line of a well equipped block plant without in any way reducing the block production. They do not increase the overhead appreciably; and if well manufactured, serve to introduce concrete products to a still wider circle of friends. Many small plants are becoming aware of this fact and preparing to introduce specialties into their line. The concrete trimstone industry has shown a particularly promising growth during the past year. Many plants are beginning to make architectural stone of high enough quality and sufficiently accurate proportions to please the most discriminating of architects, and the result is a greater acceptance than ever of such stone for the finest sort of buildings throughout the country.

Sell Blocks in the Wall

An increasing number of plants have also taken upon themselves the business of building the houses for which they sell their block and tile. In many communities where the contractors have not been sympathetic to the use of such building units concrete products manufacturers have seen that they could sell their blocks in terms of finished buildings easier than they could as building units, and the result has been that many of them have gone into the building business in a very definite and successful way. Others are selling the completed wall at so much per cubic foot to the man who has the general contract for a building.

The increasing use of portland cement stucco has also been seized upon by products makers as a movement that they can well turn to their own profit. The fact that there is no back up for stucco quite as satisfactory as concrete block to which the stucco bonds naturally, is beginning to be appreciated by products makers as a great opportunity.

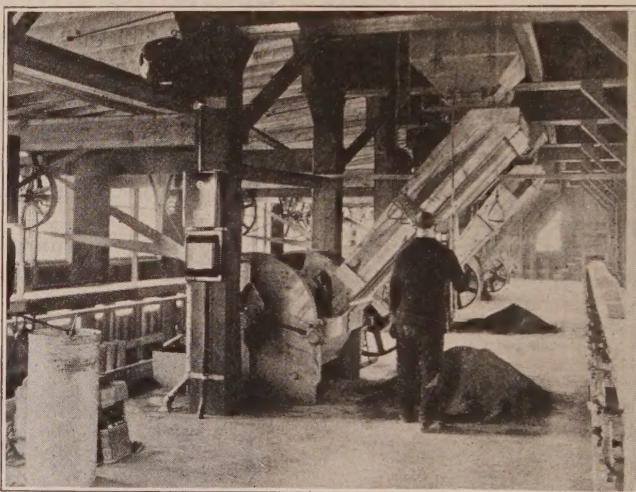
All of these tendencies are healthy ones. They point

to an increased field of use for concrete building units. They are in themselves a reliable prediction of many prosperous years of increased production and greater individual prosperity for the plants in this industry.

Block Must be Sold

A little over a year ago an article was published in CONCRETE which was headed, "Concrete Products Must Be Sold in 1926." It is very gratifying to note in reviewing the year that concrete products *have* been sold in 1926. Not as aggressively as might be wished, nor as generally as would be desirable, but a great deal more aggressively and much more generally than they were in 1925.

The tendencies which have been outlined as being conspicuous during the past year are all *sales* tendencies. They all point to an awakening merchandising consciousness on the part of the industry. Indications are that these tendencies will be continued. If they do, it will not be long before the concrete products salesmen will be as well known to the building trade as is the brick salesman, or the wire lath salesman, or any of the numerous other men who merchandise building materials. Along with this aggressive salesmanship there are already indications of a development of a higher and better idea of service. It may not be long before the majority of blocks are delivered on the job rather than picked up by the contractor who has



Production problems, while not entirely solved, must now give way to the major problem, that of merchandising

purchased them. Definite guarantees of structural strength will soon become common practice if present tendencies are any indication. And along with this will go a greater confidence on the part of purchasers, on the part of architects and contractors, and on the part of the public in general.

The year 1926 has been a great one for the products industry, not so much as a year of accomplishment, but as a year of awakening. It has seen a development of those ideas of merchandising and service which insure the future of the industry. If the men in the business will only remember what they have learned during the past year, and realize that concrete products must be sold in 1927, in 1928, in 1929 and in 1930, as well as in the year which has just passed, there can be no reason why the production of concrete building units will not go well past the billion mark within the next five years.

Railroad Completes Million Dollar Concrete Improvement in Virginia

Richmond, Fredericksburg and Potomac Railway Brings Its Trackage at Fredericksburg Up to Date With Modern Concrete Bridge, Approaches, Viaducts and Enlarged Station — Appearance Was Important Feature — Construction Methods Described

AT Fredericksburg, Virginia, the Richmond, Fredericksburg and Potomac Railway has just completed a million dollar modernization program to eliminate grade crossings and to provide double trackage over the Rappahannock River and four city streets which the tracks previously crossed at grade.

In general, the improvement consists of a reinforced concrete bridge over the river, connected to the main line trackage with filled approaches and concrete bridges over four streets joined together with concrete viaducts. All of these units are built at a uniform grade and are located on a tangent. At the same time the railway is enlarging and modernizing its station and the city is repaving the streets which lie near the station. The total cost of this huge improvement has been about \$1,150,000. In the arches, piers, abutments and retaining walls of the bridge more than 30,000 cubic yards of concrete were used and an additional 6,000 cubic yards were used for the six- and seven-inch paving.

Bridge Specifications

The new concrete bridge replaces a 603-foot single track steel bridge resting upon stone masonry. A feature of the work is found in the fact that although train movement over this line is unusually heavy and frequent, there was no interruption to traffic during the construction of the new units.

The bridge proper consists of five river arches, each 90 feet in span, and five shore arches of 40 feet span each, all spans being about 50 feet from water to crown.

One of the unusual features of the bridge is the adoption of parallel arch rings, each ring being 12 feet wide with a space 5 feet 6 inches wide between the rings. The crown thickness of concrete is 3 feet, increasing to 4 feet near the springing line. Each ring carries transverse walls about 10 feet center to center forming open spandrels. A 16-inch reinforced slab was placed on top of these transverse walls. This floor slab is trough-shaped to confine the 3 feet of ballast used under the tracks.

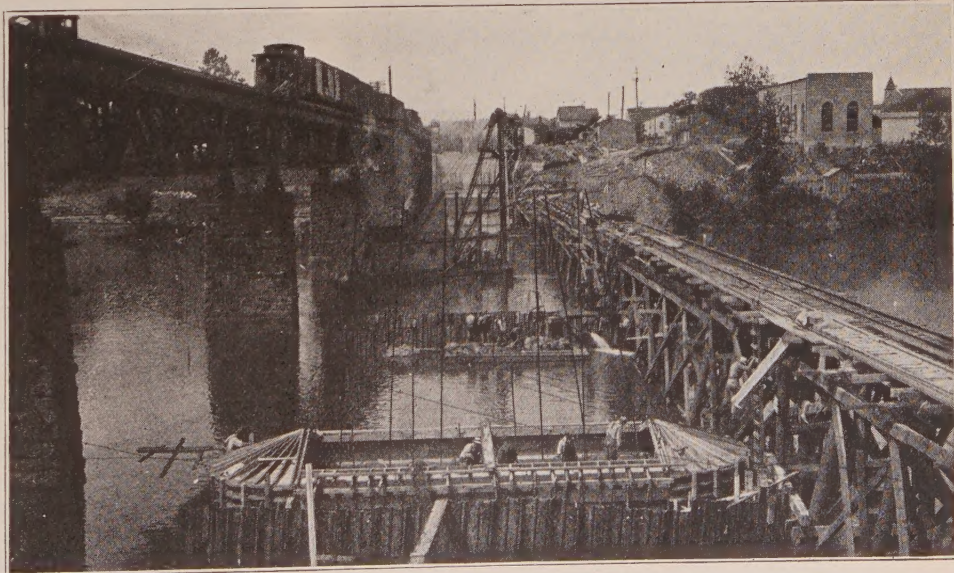
All parts of the structure were designed for a Cooper's E-60 loading with 50 per cent impact upon the slabs and columns and 25 per cent impact on rings and piers. Platforms and stairs were designed for 100-pound loading with 25 per cent impact. Working stress for the 1:2:4 concrete at 28 days was set at 750 pounds per square inch. The piers rest upon rock with a bearing power of $5\frac{1}{2}$ tons per square foot while the retaining walls and viaducts rest upon good ground assumed to have a safe loading value of $2\frac{1}{2}$ tons per square foot.

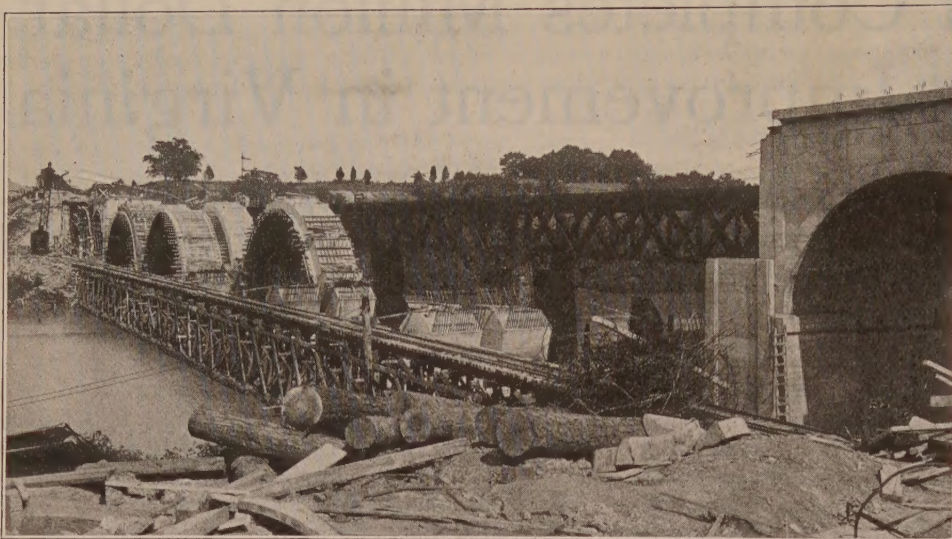
The floor of the bridge has a membrane waterproofing finish while the backs of the retaining walls all received a coating of waterproof paint. The floors of the bridge and viaducts have drainage provided at frequent intervals and track beds and platforms are drained with concrete gutters. Platforms rest upon graded fills and are divided into blocks about four feet square and are surfaced so as to show as much aggregate as possible.

Surface Finish

Unusual care was taken to make the surface of the concrete attractive. Reinforced concrete balustrades were used

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The new bridge looking south from Pier 7, showing the type of form used to place concrete below water level
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The forms are being removed from some of the arch rings on the farther side of the river. The service track is shown on the temporary trestle to the left of the new bridge

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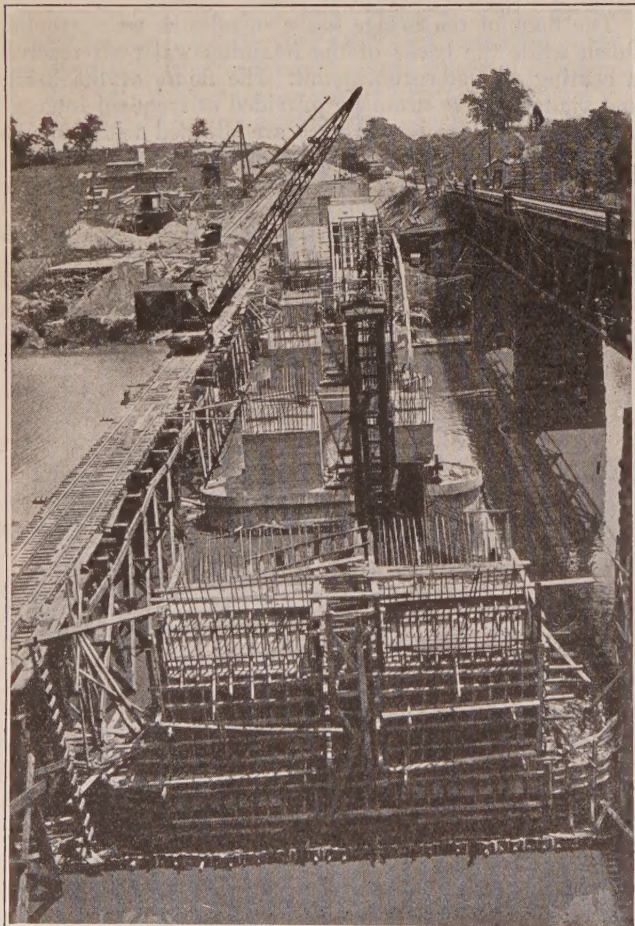
upon the street crossing bridges to beautify the work. Each balustrade was tool finished and given a carborundum rubdown by hand after being placed in position. The cost of this hand work averaged six cents a square foot. The stair steps leading to the bridges are precast and finished to match the balustrades and other parts of the structures. All of this final finishing was done as soon as the forms were removed. A thin grout of cement in a 1:2 mixture was ground into the surface, leaving a smooth attractive finish without any form marks showing. Projecting wires from the reinforcing were cut off one-half inch back from

the surface and pointed up with mortar, then finished by hand.

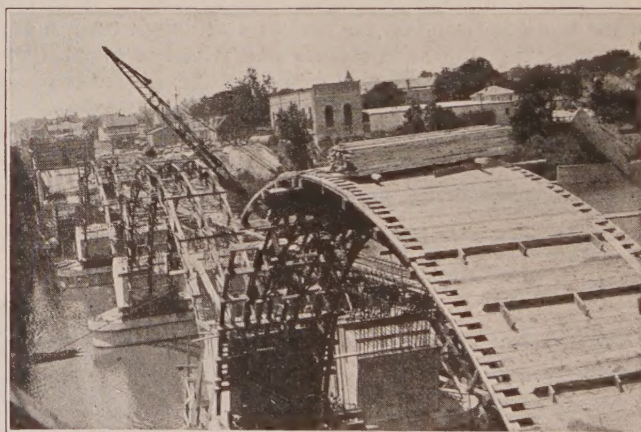
On most jobs of this kind one brand of cement is specified, but on this work 7 brands were employed. No attempt was made to keep the different brands separated but all cement was piled together and used as it came from the storage house. One batch might contain one, two or conceivably seven kinds of cement. Practically every manufacturer shipping cement over the Richmond, Fredericksburg and Potomac Railway has his cement used in this improvement.

Construction Procedure

All of the concrete was handled by buckets, except that placed for the arch foundations where dump cars chuted



A view along the centerline of the new bridge, facing north. The crane, operating on the service track, proved a valuable ally



Here the crane is handling lumber and steel members for the arch ring forms

the concrete from an industrial railroad track down an incline of about 40 degrees. This procedure is shown in one of the accompanying photographs. A traveling crane, operating on a track built upon piles alongside the new bridge, handled the concrete for the arches. A two-yard bucket carried the concrete directly into position. This same industrial crane also aided materially in other phases of the work. For example, all of the form lumber and reinforcing which was used in the arches and piers was put into working position with this crane. Outriggers fastened to the boom gave the necessary reach to the crane.

Just as interesting was the method used to place concrete used in the street bridges and viaducts. A crane similar

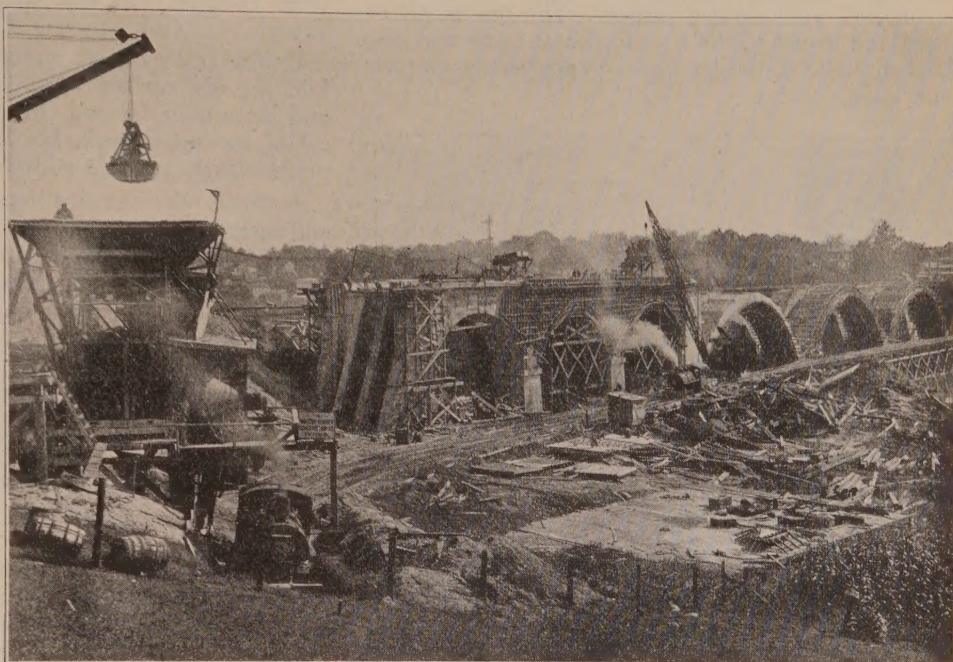
to that used for the arches, but mounted upon a caterpillar shovel rig handled all the form lumber, reinforcing and later the concrete for this section of the job. In order to speed the work, a dinkey locomotive running upon a tramway brought the concrete from the mixer to the crane in a two-yard bucket. The crane lifted the bucket

work and lowered the cost of erecting the river spans. After the concrete in the arches had set for 21 days the arch forms were lowered slightly and rolled to position for adjoining ribs. Slab forms generally were left in place for 14 days before they were pulled away while column forms were pulled in about two days.

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A view of the mixer plant. In the foreground is the dinkey that carries the concrete in buckets to the forms. The crane has picked up a bucket of concrete and is swinging it into position for dumping

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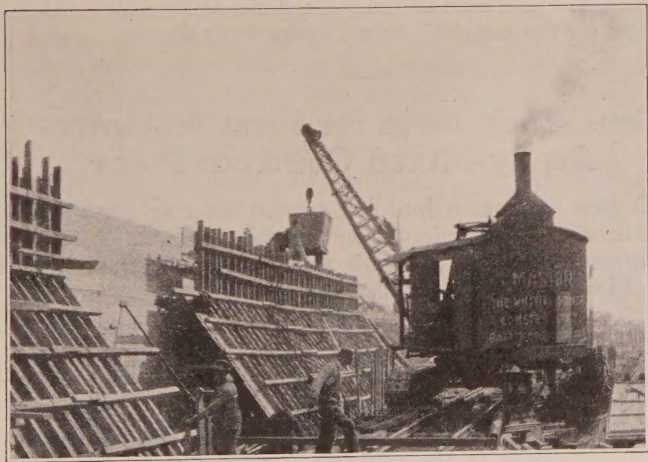
off the dinkey train and swung it into position just as and where it was needed.

Forms

The cofferdams and sheeting used to place the piers were designed by the contractor and approved by the engineer in charge. The sheeting was braced in all directions and pumps kept the cofferdams constantly free of

At the beginning of the work, when the piers were being placed and excavation work for them was being carried forward, a great deal of trouble was experienced with seepage of water through the interlocking steel piles. The ingenuity of the contractors was demonstrated when this hindrance was overcome by depositing finely-ground cinders in the joints and rodding the material firmly during the depositing process.

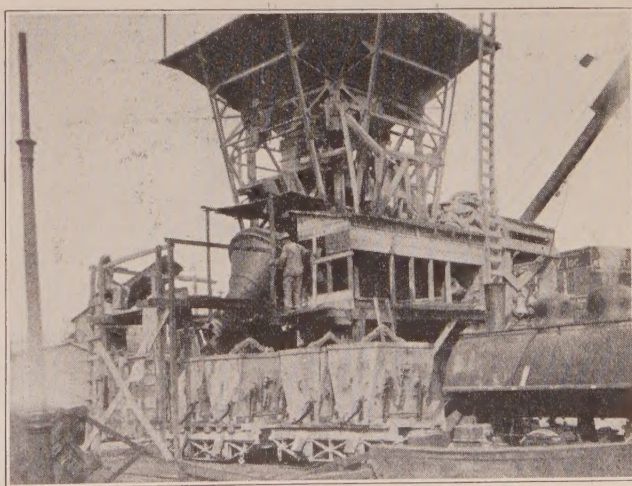
Arch ring concrete was deposited in sections. First, segments about 10 feet long along the centering at quarter



A closeup showing the crane handling the concrete bucket just before the concrete is dumped into the forms

water. Lackawanna steel sheeting was sunk well below the bottom of the excavation to prevent seepage. The piles were driven about one foot into the rock. All loose material was removed by hand and sloping surfaces benched for a level masonry bed. This rock upon which the piers rest is about 14 feet below the mean water level.

Blaw-Knox steel form arches were used for the river spans. The use of this type of arch form speeded the



The central mixing plant

points were placed. On the following day the sections adjoining the haunches were put in. Next the segments of the arch on each side of the crown and after concreting at the springing line the key section at the top was placed. Some slight movement in the forms was noticeable under

this method of placing arch concrete, but there was never more than $\frac{1}{4}$ -inch of movement.

Concrete Specifications

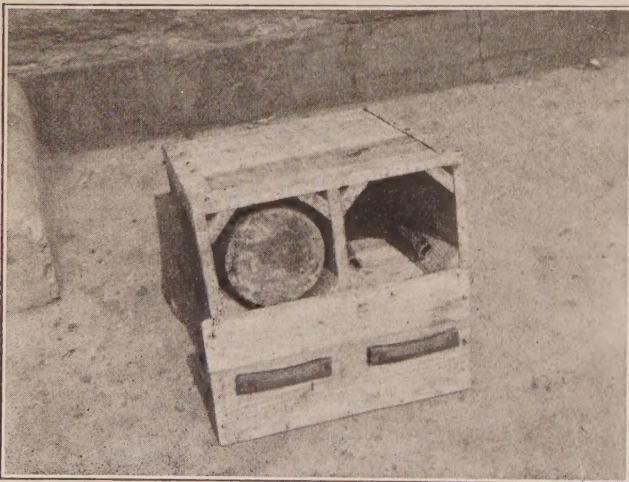
Two mixers and two Blaw-Knox inundation outfits were used for the job. These were placed at the extreme north and south ends of the work, about 2000 feet apart and were connected by a service railway. The coarse aggregate used ran from $\frac{1}{4}$ to $1\frac{1}{2}$ inches in size and was measured by volume, the inundator guaranteeing uniform sand and water content.



The east retaining wall. A smooth, attractive finish was obtained by rubbing the walls with a thin cement grout

Celite was used as an admixture in the concrete, going into slabs, columns and spandrel walls to increase the workability. Three per cent by weight of the cement used in batches was the maximum amount of admixture used.

On the arches and columns a mixture of 1:2:4 concrete was adopted and kept to a 6-inch slump. On foundations a 1:7 mixture, combined aggregate, with a 3-inch slump was used and for the floor slabs a 1:5, combined aggregate, mixture with a 6-inch slump was used and kept constant all through the work. Tests were made at fre-



A handy box in which test cylinders were shipped to the laboratory

quent intervals and the compression cylinders kept in damp sand until ready for shipment to the testing laboratory. The average strengths developed with the 1:2:4 mixtures used in arches and walls was 2500 pounds at 28 days. The 1:5 mixture developed strengths of 3500 pounds at

28 days.

Since the work on this improvement began in December, a temperature range of from well below freezing to 120 degrees in the sun were encountered. During freezing weather, aggregates and mixing water were heated, the former by hot water and the concrete was protected by canvas enclosures enclosing steam. In warm weather the fresh concrete was kept damp by sprinkling for several days.

Before new concrete was placed on concrete previously laid the old surface was thoroughly cleaned of laitance and loose material and covered with a thin 1:2 grout. In all of the mass work, keys were molded near the outer perimeters to provide additional bond.

A. S. T. M. specifications governed all the materials and methods of making tests. Inspection was handled by the engineers of the R. F. & P. Railway with J. C. DeJarnette in charge. J. E. Greiner, Lexington Building, Baltimore, Md., was the construction engineer. Whiting and Turner, Stewart Building, Baltimore, were the contractors. E. M. Hastings, chief engineer, R. F. & P. Railway, Richmond, Va., acted for the railroad company.

Concrete Grease Rack for Filling Station

The Westland Oil Company at their Malta, Montana, filling station have installed an interesting concrete grease rack. The runways and supports are constructed of heavily reinforced concrete and the end supports of the structure



serve as a guard to keep the car from rolling off. Two arches on either side of the main parts of the track afford access for the mechanic to get underneath the car.

Ten-Truck Fleet for First Northwest Ready-Mixed Concrete Plant

A new feature in building construction in the Pacific Northwest will be initiated by the Pioneer Sand & Gravel Company of Seattle, Washington, in the construction of the Cheasty Building of that city.

The firm has received the contract for 4000 cubic yards of ready-mixed concrete for the building. A fleet of ten trucks, each carrying one and two-yard loads of mixed concrete from a specially constructed mixing plant which will be built in an outlying district will transport the material from the plant to the building at the rate of one yard every two minutes.

Traffic congestion resulting from the construction of bunkers over the sidewalk is to be eliminated and the most careful attention to be given to accommodation of street traffic.

The plan is in the nature of an experiment for the local concern, although similar processes have been worked out in the East. Economy in working space due to the fact that sand and gravel bunkers and cement sheds will not be needed is a benefit from the plan, it is pointed out by Dean Henderson, sales manager of the company.

Triangular System of Concrete Block Construction

System Is Based on Properties of Right Angled Isosceles Triangle—Permits Many Arrangements

AN interesting system of concrete block construction used in England is that which involves hollow triangular blocks. The idea is based upon the well-known properties of the right angled isosceles triangle which is divisible into two similar triangles of half the size and which provides remarkable facility for forming angles, corners and breaks with standard blocks and without resort to any cutting.

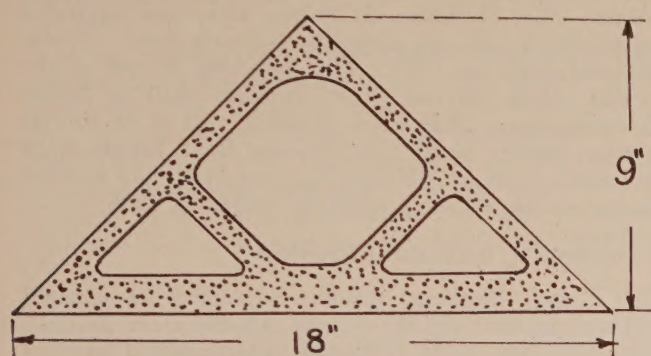


Figure 1. Standard type of triangular block

The standard type of block adopted is indicated in Fig. 1, while Fig. 2 depicts the more common methods of wall building for a square junction, an octagonal bay, a square bay and an octagonal column, respectively. From these it will be noted that at corners, owing to the first course having the base of the triangle placed across the angle and the second course having the bases of the two triangles placed so as to form the external face, the bond is practically perfect. Similarly in outer walls and cross partitions, the triangle ensures that every course of the cross wall penetrates the main wall as against every other course in the case of rectangular blocks.

In the case of steel-framed buildings, this class of block is very easily formed into a hollow rectangular column of any size while an interesting feature shown in Fig. 2 is the way in which hollow octagonal columns may be formed for the purpose of enclosing steel members. This provides

for the use of eight blocks to a course though obviously different sizes must be used according to the desired over-all dimensions.

The system is regarded here as one with considerable possibilities as each standard block, though equal to six bricks in size is only the equal of three bricks in weight. There is, therefore, a very definite saving in the cost of laying and the area covered with mortar is only 1/16 of that required by a similar amount of brickwork. While the general run of concrete block work is satisfactory provided good blocks are used, condensation is a trouble

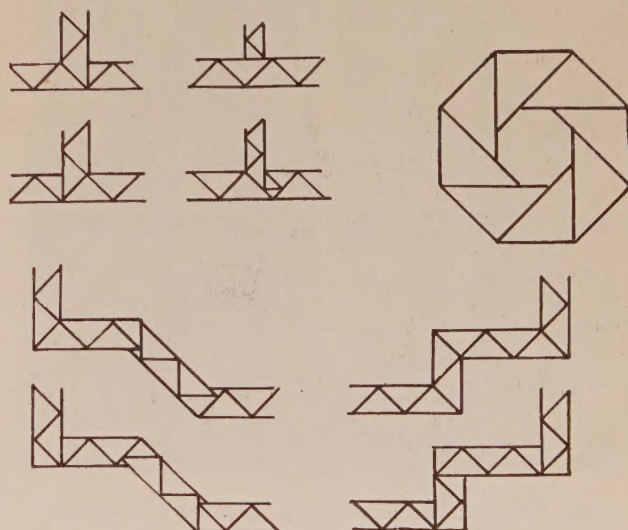


Figure 2. Methods of making bays, junctions, and columns

which has so far defied solution, and although this particular system has not yet been shown to be entirely capable of eliminating it, yet the arrangement of the hollows certainly modifies it, and if clinker blocks are used internally and ballast blocks externally condensation will only be induced under the worst possible conditions.

Concrete Block Victor in Los Angeles

Concrete block won a signal victory over common brick in Los Angeles through the signing of an ordinance recently by Mayor Cryer of Los Angeles which very materially widens the permissible use of hollow block in building operations. Heretofore concrete block was permitted only in two-story buildings situated outside of fire zones No. 1 and No. 2. These zones include practically all of the downtown business districts, extend over a large portion of the combined business and residence districts, and have extensions along many of the outlying business

streets.

Under the provisions that will be in effect within 30 days after the ordinance is printed the concrete block men will be permitted to use block in two-story buildings in zone No. 2; for three-story buildings in zone No. 3 and for filler walls in all four-story buildings outside of zones 1 and 2. Compared with the restrictions under which the industry labored before, these provisions are exceedingly liberal and will make for an enormous increase in the use of concrete block in Los Angeles construction.

Tall Buildings Concrete in

DAYTON, Ohio, is not among the largest cities of this country. Nevertheless, that city presents to the construction industry several points of outstanding interest. First, a surprisingly large proportion of the tall buildings in Dayton have reinforced concrete structural frames; second, the tallest building in Dayton is also the tallest reinforced concrete building in the United States; and third, at least two of Dayton's tall concrete buildings involved construction problems of unusual interest, problems that were solved in a most successful manner.

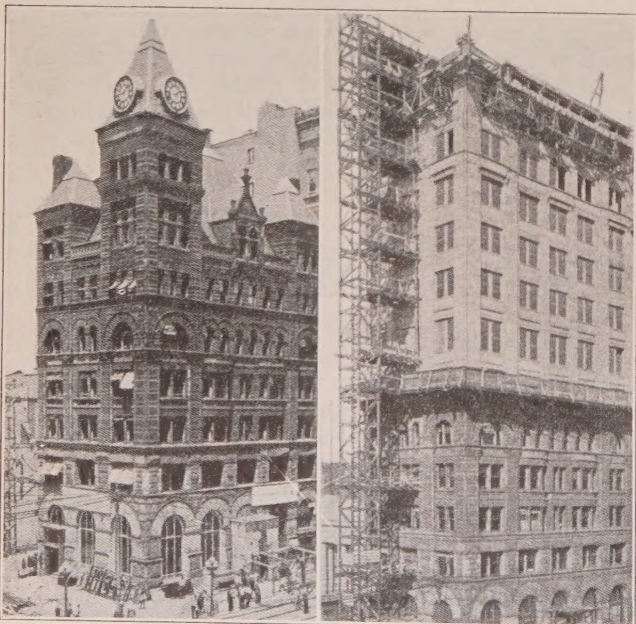
The building referred to as to the tallest reinforced concrete building in the United States is the United Brethren Office Building, 21 stories high, and having a total height of 276 feet above the sidewalk level. It was completed early in 1924. This building is one of the two that called for more than ordinary skill in design and construction. The other building that is of special structural interest is the City National Bank Building, 12 stories high, built in 1920 as a reconstruction and upward extension of an old bank building erected in 1886.

An Interesting Structural Problem

The United Brethren Building presented an unusual structural problem for the reason that the main part, 14 stories high, was built alongside and connected with an



Above: The City National Bank Building as it now appears.
Below: The old building, as it was built in 1886. Two top stories of the old building were removed and seven new, reinforced concrete stories were added



The Harris Building, ten stories high with reinforced concrete structural frame and floors

of Reinforced Dayton, Ohio

*Unusual Construction Problems Involved
in Some Dayton Concrete Buildings—
United Brethren Building Is Tallest Rein-
forced Concrete Structure in the United
States*

older steel structure of the same height, while the new 7-story tower rests partly on the old building and partly on the new.

It was necessary under the circumstances to strengthen all columns in the old building that were to have the additional load from the tower imposed upon them. The footings of these same columns had to be increased in area. The old columns were strengthened by placing reinforced concrete casings around them. At the same time these columns were shored up at the base, the old footings were removed, and reinforced concrete footings of larger area



The Commodore Apartments, ten stories high with reinforced concrete structural frame and floors



Above: The United Brethren Building, 21 stories high, the tallest reinforced concrete building in the United States. The old steel portion, 14 stories high, is at the right, comprising first five windows

Below: Hotel Miami, an 11-story reinforced concrete building



replaced them. The footings are on a gravel foundation 24 feet below the sidewalk level.

Inasmuch as the old structural steel part of the United Brethren Building was erected 18 years before the reinforced concrete addition at the side and above it, some structural engineers were of the opinion that trouble might arise from inequality in the compression of columns in the old building and in the new. While the immediate effect of construction loads would be corrected as the work on the building proceeded upward, it was thought that cracks at the juncture of the old and new parts might result from plastic flow of the concrete in the columns. In such an event the expected trouble might develop in the course of one or two years after completion of the building.

Had such an action taken place, the points of contact between the old and new buildings would have been subjected to an irresistible shearing stress, with resultant cracks in floors, walls and partitions. From a careful examination of the building in September, 1926, more than two years after its completion, it was learned that no such trouble has developed. Every floor was examined, but no sign of distress was found. Not even minor cracks had developed in floors, partitions or ceilings. The outside walls likewise were free of cracks.

It is a matter of further interest that the cost of the reinforced concrete structural frame of the United Brethren Office Building was considerably less than the architect's estimate for a fireproofed steel frame. Otherwise the latter type would doubtless have been selected because steel was used as the frame in the older part of the building. An article published shortly after the completion of the building quoted F. J. Hughes & Company as having estimated the cost of the concrete frame at 75 per cent of the cost of the fireproofed steel frame.

F. J. Hughes & Company, of Dayton, were the architects on the United Brethren Building. Bergendahl & Archer, of Chicago, were the contractors, and S. J. Branson, formerly chief engineer for that company, was the structural designer.

An Old Building Salvaged

The City National Bank Building, shown in one of the illustrations, is a noteworthy instance in which the salvage value of an obsolete building was utilized. The original structure, seven stories high and built in 1886, was known as the Callahan Bank Building. In accordance with the custom of the eighties it was designed with a profusion of towers, turrets and dormers, now considered quite inappropriate in modern office building design. Consequently in the reconstruction the upper two stories were removed.

In the remaining five stories the old exterior bearing walls and their foundations were not disturbed. The exterior walls and bays of the seven new stories are supported on reinforced concrete columns carried down just inside the old masonry walls and supported on independent cantilever footings that are combined with new footings under the interior columns. The old interior columns of cast-iron were strengthened by surrounding them with casings of reinforced concrete, in which both vertical and spiral steel were used in accordance with modern practice. It was necessary in some instances to shore up old footings while new ones were being placed.

The wooden floors of the old structure were replaced with reinforced concrete floor slabs, supported on the strengthened interior columns. A most remarkable feature of the reconstruction project is that the banking operations on the first five floors continued without interruption. The contractors on this notable work were the Industrial Build-

ing Company, of Dayton. Pretzinger & Musselman, also of Dayton, were the architects.

Other Concrete Buildings of Dayton

Other important reinforced concrete buildings in Dayton are the following:

Miami Hotel, 11 stories high, built in 1914 by H. L. Stevens & Company, architects, engineers and contractors, of Chicago.

Fidelity Medical Building, 11 stories high, built in 1918. The architects were Peters, Hermann & Brown, of Dayton, and the contractor was Joseph E. Lowes, of the same city.

Commodore Apartments, 10 stories high, built in 1923. The architects were F. J. Hughes & Company, of Dayton, and the contractors were L. E. Urban & Company, also of Dayton.

Harries Building, 10 stories high, at the southwest corner of Main and First Streets.

City National Annex, 10 stories high, shown in the picture of the City National Bank Building, and adjoining the taller structure, was in fact, built before the main bank building was reconstructed.

Dayton Savings & Trust Building, 10 stories high, Schenck & Williams, of Dayton, were the architects, and the U. S. Structural Company, also of Dayton, were the contractors.

New Fence of Concrete in California

A very durable fence of heavy wire and concrete supports was recently built around a private estate in Hollywood, California. It encloses two and a half square blocks.

The mix consisted of four parts to one. Posts measure twelve inches at the base and stand eleven feet in height and thirty inches in the ground. Each post is reinforced with two steel rods that run lengthwise and a stout wire runs through the concrete at the top, center and bottom, projecting six inches so that it can be bent to hold the fence. There are two large posts or pillars that support a swinging gate at the entrance. They are thirty inches square.

The posts are planted eight feet apart and support a long sheet of closely woven galvanized wire ten feet in height, two strands of barbed wire at the top.

Course in Mix Control Continued in East

Active endorsement of universities and engineering organizations is evident in the 1927 educational activities in design and control of concrete mixtures. Sessions will be held at the Engineering Societies Building at New York City, Thursday, March 3, Monday, March 7, and Wednesday, March 9. Under the auspices of the Buffalo Engineering Society, five sessions were held beginning Thursday, January 20th. The Rochester Engineering Society sponsored five sessions beginning Monday, January 24th, at Rochester, New York. Several meetings were held at Johns Hopkins University at Baltimore, Maryland, beginning the evening of February 14th.

President Re-elected Head of Ohio Products Association

At the annual three-day convention of the Ohio Concrete Products Association, held at Columbus, in January, S. I. Crew, Cincinnati, was re-elected president. Block testing and building regulations were largely discussed.

Pittsburgh Products Merger Shows Trend in Concrete Products Industry

General Cement Products Corporation Merger in Pittsburgh Shows Adoption of Big Business Methods by the Products Industry—Adequate Marketing Facilities and Better Merchandising Methods Possible

THE recent merger of four products plants in Pittsburgh into a single company, capitalized at \$1,000,000 is an indication of the trend in better manufacturing, merchandising and marketing methods that are featuring the newer developments in the concrete products industry.

This merger represents the largest single unit corporation in the industry today and marks a turning point in the history of the industry of great significance. It means that, for the first time, the broad principles that have contributed to the commercial success of other industries are being applied to the manufacture and marketing of concrete products.

The new company has the largest concrete block manufacturing capacity in the history of the industry, namely, 30,000 block and 10,000 tile per day. In addition, one of the plants has a complete colored stucco mixing plant and an architectural trim stone department is being installed.

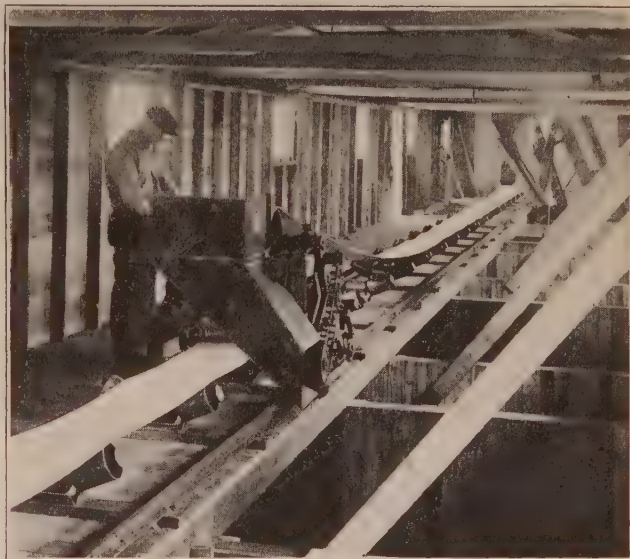
The four plants involved represent a geographical distribution that permits of complete coverage of the local construction building market. Expensive cross country trips in the hilly Pittsburgh district are eliminated because the company can furnish materials from the nearest plant, making economical as well as speedy deliveries possible. In the event of unusually large orders the combined production of two or more plants can be turned to supply the job. The manufacturing volume is such that the organization can go out after construction requirements in any volume. The company is geared for big business and is going out after large volume sales.

Plants in Merger

The following plants and the equipment they operate are included in the merger:

Henderson Structural Units Co.

Equipment—Two Besser automatic block machines, capacity 1,800 blocks per day; two Besser automatic strip-



Production of concrete block is the responsibility of one of the officers of the new company



The four plants in the merger represent a geographical distribution that permits complete, economical coverage of the local building market

per block machines, capacity 3,500 block per day; one Besser automatic tile machine, capacity 10,000 tile per day.

The Creststone Co.

Equipment—Two Besser automatic block machines, capacity 1,800 block per day; one Besser automatic stripper block machine, capacity 3,500 block per day.

3. Credit resources to handle large volume sales.
4. Sufficient working capital to make large scale manufacturing possible.
5. Placing the concrete building supply material business on an investment plane that commands respect and forces consideration at the hands of large consumers of



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Adequate financing means that large scale manufacturing is made possible

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National Cement Block Co.

Equipment—Two Besser automatic block machines, capacity 1,800 block per day.

Goldie Manufacturing Co.

Equipment—Zagelmeyer cast stone equipment, capacity 4,000 block per day; two Post Punch block machines, capacity 2,000 block, each, per day.

The officers of the company are: A. C. Campbell, president; J. E. Crawford, treasurer; Albert Henderson, vice president and chief engineer; H. R. Loughridge, vice president and sales manager; C. J. Herzog, vice president and plant manager.

Advantages

An organization of this kind is equipped to realize the

building materials.

6. Adoption of proved methods of manufacturing and demonstrated merchandising methods, involving the recognition of the idea that concrete products must be sold as any other building material.

The consolidation further means that the earning power of the concrete masonry unit industry has already attracted and will continue to attract in larger measure in the future, the attention of capital. It is an industry that has possibilities for substantial earnings.

While this particular consolidation can be considered in the nature of a pioneer, it indicates the trend that can be expected in the industry in the future. Other mergers and consolidations have been rumored and reported. The

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The earning power of the concrete masonry unit has already attracted and will continue to attract the attention of investors

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full possibilities of the concrete products industry in the local building markets. Among the advantages are:

1. Ability to supply building materials in any required volume.
2. The concentration of manufacturing units for short time deliveries of large volumes of materials.

concrete products industry can be expected to take its place as one of the solid, profitable industries in the building materials field. The merger is a forerunner of the types of organizations that will follow in other large population centers to be the leaders in the production and marketing of concrete masonry units.

EDITORIALS

Bigger Things Ahead

THE interest that men who represent big business and investment capital are beginning to take in the concrete products industry is a most encouraging sign. It forecasts big things for the concrete masonry unit.

It is encouraging from several points of view. First, it shows that men, experienced in business and investment, consider the manufacture of concrete block and tile a venture that can and will return dividends on their investments. If they did not they would not be attracted to it. The recent merger of four Pittsburgh products plants, described elsewhere in this issue, is an example. Bankers, whose specialty is to know where to invest money, have investigated the concrete products field and found it good.

Second, the entry of these men into the products field means that those business principles that have been found productive of profits in other industries will be applied to the concrete products industry in larger measure than ever before. This is particularly true in the merchandising end.

The most encouraging movement that the products industry has ever experienced is now under way. It is the awakening of the merchandising consciousness of the concrete products manufacturer. It is definitely recognized that the concrete block and tile manufacturer must bestir himself to aggressive salesmanship if he is to survive.

The products industry has no limitations other than those imposed upon it by the limited vision of the men who make and sell block. If the men now in the industry cannot get the larger vision, they are doomed to failure. The field is too attractive; it has too many possibilities to be overlooked by the shrewd business man for long.

Production problems, while not entirely solved, are now of secondary importance. At a recent products association convention not one paper was presented on the technical aspects of block manufacture. Production costs have been lowered. Capacity has been increased. Now is the time to *sell*.

Preventing Construction Accidents

ACCIDENT prevention in the construction industry is beginning to receive the attention it deserves. Contractors are beginning to learn from a few isolated examples of accident-free jobs that it is worth while.

It has been demonstrated that accident prevention is practical on the average construction job. Some contractors have made the effort and have found that it pays.

The construction industry does not have an enviable record in accident prevention statistics comparisons. More than that, the rate at which accidents occur is increasing. In Pennsylvania, in the first three months of 1926, there were 25 per cent more accidents than for the same period during the previous year. Casualty insurance rates, naturally, are based on the accident frequency in the industry and they have reached some high records in the construction industry. On one class of work, in a certain locality, the rate is over twenty-seven dollars for each one hundred dollars of pay roll.

At the recent meeting of the Associated General Contractors, the subject of accident prevention came up for an important place on the convention program and the discussion indicated the desire of the contractors to know more about how to go about the work.

The American Engineering Standards Committee has a sectional committee at work under the official leadership of the National Safety Council on a safety code for construction work. The Associated General Contractors, also, have presented a tentative Manual of Accident Prevention to their members for consideration.

With these bodies concentrating on safety provisions, a long step has been taken toward the prevention of accidents in the construction industry. The Associated General Contractors deserve much credit for their growing interest in this work. It is to be one of the major interests of the Association during 1927 and a fund has been donated to carry it on.

But the actual results in lowering the number of accidents occurring on the job, in the last analysis rest with the individual contractor. He it is who must get behind the movement if he is to save lives and limbs of his employees. Incidentally he will reap the profits from his humanitarian work.

The New Competition

COMPETITION today has taken a new form. It is no longer primarily the competition of one manufacturer as opposed to another manufacturer of the same product. It is, instead, competition between materials as, for instance, between concrete and the other building materials.

With the present trend toward inter-commodity competition it is now more important than ever that the concrete unit be brought to the fore as a most desirable building material. When more builders are sold on its desirability, then all of the branches of the industry will have a bigger market to serve.

Wide Range of Concrete Problems Discussed at A. C. I. Convention

Twenty-third Annual Convention of the American Concrete Institute at Chicago Considers Quality Control, Reinforced Concrete Design, Concrete Products, Cast Stone, Concrete in Architecture, Concrete and Cement Research and Manipulation of Concrete After Mixing

A PROGRAM designed to cover as completely as possible the many problems arising out of the great variety of present-day uses of concrete was planned for the Twenty-third Annual Convention of the American Concrete Institute, held at the Palmer House in Chicago, February 22nd, 23rd and 24th.

The convention was a decided success from every viewpoint. There was a larger attendance than ever before. A wider range of subjects was discussed than had ever before been placed on an Institute program. No matter what anyone's particular interest in concrete was, he was sure to find some part of the program devoted to his branch of the concrete industry.

The program arrangement was a departure from that used at previous meetings. Papers and discussions were grouped by subjects, with certain definite periods assigned to them. A feature were the periods devoted to short discussions of such factors as "Time as a Factor in Making Concrete," "Operating Problems in Products Manufacture," etc. Discussions were arranged under the following heads: afternoon of Feb. 22nd, Quality Control; evening of Feb. 22nd, Reinforced Concrete Design; morning and afternoon of Feb. 23rd, a joint meeting with the Concrete Products Association, Concrete Products; evening of Feb. 23rd, Concrete in Architecture; morning of Feb. 24th, Research; afternoon and evening of Feb. 24th, Manipulation of Concrete After Mixing.

Tuesday Afternoon—Quality Control

President's Address

In his opening address, President M. M. Upson reviewed the progress of the concrete industry during the last few years and also told of the important part the Institute had in making this remarkable progress possible. The place of the concrete industry in the present tremendous building program is one of responsibility and the Concrete Institute carries the responsibility of maintaining the development of the industry from a scientific point of view.

Notes on Concrete in Wacker Drive

The construction methods used on the Wacker Drive two-level viaduct recently completed in downtown Chicago was the subject of the first paper, presented by Arthur R. Lord, president of Lord & Hollinger, engineers, Chicago. Some interesting facts on such subjects as importance of temperature in rate of hardening, need of controlled consistency and of maintaining precise control over all the concrete-making factors, were brought out.

Mr. Lord presented 14 points as his "articles of faith" with which the builder must reckon on work of that nature. The presentation of the paper was followed by a motion picture that illustrated graphically some of the

points discussed. It showed that a workable mix could be designed that, with an average slump of 3.1 inches, would permit placing even in a structure carrying the great amount of reinforcing steel used in Wacker Drive.

A series of articles describing the design and construction of Wacker Drive is now being published in CONCRETE.

Construction of Bremerton Pier

The outstanding point of interest in the construction of the pier in Navy Yard at Bremerton, Wash., was the use of quick-hardening cement in making the shells for the reinforced concrete columns on which the superstructure rested. The paper was prepared by Lt. Com. J. J. Manning of the U. S. Navy.

The pier is 1318 feet long and is used largely for repairing battleships. This required that it be designed to support heavy machinery and equipment. The pier rests on reinforced concrete cylinders, bearing on hard pan. Concrete cross girders tie these together and a reinforced concrete deck, together with special designs for cranes, etc., completed the structure.

It was required that all concrete be placed in the dry. To do this, it was necessary to use precast concrete shells for the cylinders, erect them in place and then place the concrete in the shells. Here is where the advantages of high alumina cement were utilized. If standard portland cement had been used in casting the shells, it would have been necessary to install a casting yard and cure the shells for the period required to gain the necessary strength. By using quick-hardening cement, the shells were cast in place and could be erected 24 hours after casting. This saving more than offset the additional cost of the cement. Also the qualities of high alumina cement for resistance to sea water were an argument in favor of its use.

Tests showed that the quick-hardening cement concrete bonded very well with the standard cement concrete core. Strengths of from 4230 to 4980 pounds per square inch were attained in 24 hours in the shells.

Economies of Field Control

For its past year's work, Committee C-6, on field control, devoted its attention to the economies that could be affected in the cost of placing designed and controlled concrete. Some startling facts were brought out. One actual case of the advantage of designed over arbitrary mixes was cited. In the construction of a 7-story reinforced concrete building, it was found that a 1:2:4 gravel concrete would cost \$6.20 per cubic yard, but by using a concrete designed to have a compressive strength of 2,000 pounds at 28 days, the actual cost per cubic yard averaged \$5.62, or a saving of 58 cents per cubic yard. As there were 1,494 cubic yards of concrete in the job, the

total saving was \$866.52. In this case, cement cost \$2.50 a barrel and aggregate \$2.40 a yard.

In discussing Abrams' two water-cement ratio curves—one for the average job and the other for the closely supervised job, the committee pointed out that for laxity in supervision of quality control a penalty of 50 to 60 cents per cubic yard of concrete placed was imposed.

The report was presented by R. B. Young, chairman.

Steel Forms for Flat Slabs

The report of Committee C-4 on Forms was presented by its chairman, E. C. Harding. The committee devoted its time during the past year to a study of the use of steel forms for flat slab construction. Forms are one of the concrete contractors' biggest items of construction expense. They cost up to 40 per cent of the cost of the job.

When wood forms are used, the panels have usually served their purpose and are not again usable, except to a very limited extent. There is very little salvage value.

The committee believes, therefore, that the industry will eventually require some substitute for wood forms.

The types of steel forms now on the market were described and the methods of their use explained. The usual practice in the use of steel forms is to let a sub-contractor supply and erecting the forms. The lease price of such forms is usually from 6 to 12 cents per square foot. The total labor cost of erecting, stripping, etc., is from 7½ to 17½ per square foot. Steel forms must be reused at least 6 times to effect an economy over the use of wood forms.

The committee feels that, up to the present time, there has been no economical or satisfactory steel form developed for beams and girders. The use of steel forms is still in the initial stage of its development and there are great possibilities for further development in their use.

Curb and Gutter Specifications

Committee S-6, on concrete roads and pavements, presented its report on the Proposed Specifications for Concrete Curb and Gutter. Tentative specifications were prepared and presented to the Institute for adoption.

Tuesday Evening—Reinforced Concrete Design

Building Regulations

The proposed building regulations for the use of reinforced concrete were presented by F. R. McMillan, chairman of Committee E-1. With two minor changes they were accepted as the tentative standard for the Institute. The changes involved the inclusion of air-cooled blast furnace slag among concrete aggregates and the inclusion of specific reference to cold drawn wire.

Rail steel and new billet steel reinforcing bars for ¾-inch size and smaller are permitted when no bending is required.

Wind Stresses

"The Design of Concrete Buildings for Wind Stresses," was discussed by Albert Smith, formerly Professor of Structural Engineering at Purdue University and now a consulting engineer. The paper brought out some further discussion of this timely subject.

Chimney Tests

Earle D. McKay of the Universal Portland Cement Co. presented a paper, "Report of Tests on a 300-foot Rein-

forced Concrete Chimney." The paper described some tests conducted by that company on a chimney serving the cement kilns at the Duluth plant. The tests were outlined by a sub-committee on tests and researches of Committee S-1, on chimneys. The tests were of a preliminary nature and the report is not yet ready for publication. They will be continued through 1927.

Japanese Earthquake

Because of the absence of the author, Mr. M. Abe, a consulting engineer of Tokyo, Japan, the paper, "Reinforced Concrete Structures in the Japanese Earthquake," was not read.

Wednesday Morning—Concrete Products (Joint Session with Concrete Products Association)

Committee P-1

The report of Committee P-1, E. W. Dienhart, chairman, was the first paper presented at this session, which was a joint meeting with the Concrete Products Association. An account of the first day's meeting of the Concrete Products Association will be found on another page.

Committee P-1 offered first, a report on concrete building tile tests made at Cement City, Mich. In these tests it was found that, with other manufacturing conditions constant, aggregates having the same fineness moduli produced tile of essentially the same strength; that building tile having the greater compressive strength was less absorbent; that it is essential that the amount of water be carefully regulated in the dry tamp process. This report was referred back to the committee for additional information.

The specifications for concrete manhole block presented in this report were adopted as the tentative standard of the Institute.

The proposed specifications for concrete building block and tile, also presented, were adopted as the tentative standard.

The proposed specifications for concrete brick were referred back to the committee for revision and will again be presented to the Institute.

Committee P-6 Reports

Committee P-6 on products plant operation reported on some tests made on outdoor curing of concrete products. The conclusions drawn from these tests were as follows:

(1) There was no appreciable difference in strength at 28 days or 90 days of block cured the first 24 hours in moist rooms at 70 degrees F. or in steam rooms at 125 degrees F.

(2) The maximum range in compressive strength of the 28-day block for 12 months was 28 per cent of the grand average of all the 28-day block. For the 90-day block this range was 36 per cent.

(3) The compressive strength at 90 days averaged 11 per cent greater than at 28 days.

(4) The summer and fall months are more favorable for outdoor curing of block than the spring and winter months.

(5) Temperature, humidity and precipitation are the most important factors entering into the curing of concrete block.

(6) The initial curing condition or season of year had no appreciable effect on the absorption of the block.

Operating Problems

Under this heading, several phases of concrete block manufacturing problems were discussed by various speakers in short addresses.

W. R. Warford of Aurora, Ill., opened the discussion by stating the fundamental principles of economical block production as applied in his plant. He maintained that quality block can be made at a reasonable cost. In his plant he gets 22 block per sack of cement.

"The Effect of Finely Ground Cement on Products Manufacture," was the theme of the next discussion by Geo. Chandler of Detroit. He maintained that a strength gain of from 2 to 3 per cent followed each point of increased fine grinding in the cement. The lean, dry mixes are those receiving the greatest benefit from finer cement. Inasmuch as cement is the greatest factor in the cost of block manufacture, a better cement that assures higher early strength is a most important item. It reduces the time required to hold the block in storage and permits less care in handling.

Austin Crabbs of Davenport, Iowa, discussed the subject of steam curing, stressing the effect of changes in weather conditions on the curing conditions inside the curing rooms. In order to maintain curing conditions at the greatest uniformity, the steam rooms should be located inside the plant buildings. A design for a plant in which these conditions are met was outlined.

"Applying Scientific Principles to Block Manufacture," was C. J. Herzog's topic.

Mr. Herzog is production manager of the newly formed General Cement Products Co., the organization of which is described on another page in this issue.

The same subject discussed from the point of view of the cost elements of a block was presented by Benjamin Wilk of Detroit.

N. D. Benson of Providence, R. I., also described the conditions in a plant that make for economical block production and gave specific recommendations for some features of plant equipment and layout.

Greetings Committee Luncheon

A luncheon arranged by the greetings committee, John G. Ahlers, chairman, was held on Wednesday noon.

Following the lunch F. J. Straub, of cinder block fame, put on a most unusual exhibit of sleight of hand. Mr. Straub authorizes us to say that if anyone still believes his thumbs were not tied, he will be glad to demonstrate privately.

Wednesday Afternoon—Products Session Continued

Cut Cast Stone Manufacture

W. Paul Eddy of the Onondaga Litholite Company presented a paper prepared by H. P. Warner, president of that company, describing the methods used at the Syracuse plant in the manufacture of cut cast stone. An article published in the June, 1926, issue of CONCRETE presented some of the methods described.

Why I Make Wet-Cast Stone

R. F. Havlik of Aurora, Ill., described the methods used in his plant for the manufacture of cast stone and presented his arguments in favor of the wet method of casting. Accompanying the presentation of his paper, Mr. Havlik gave a demonstration of his methods. The Havlik Stone Company employs methods similar to the Onondaga Litholite Co. and the Benedict Stone Co., the principal difference being in the method of treating the surface. The Havlik method is to use acid for etching the surface instead of cutting it. This reduces costs and enables cast

stone to compete on a price basis with Bedford stone and terra cotta.

How We Make Art Marble

Another concrete product used in architectural work is art marble. Its manufacture was explained by I. L. Stearn of the Chicago Art Marble Co. It has many uses but is most often made for stair treads, risers, etc. An important part of the manufacturing process is the use of color. This is attained partly by the use of special aggregates and partly by the incorporation of coloring material in the mix.

In manufacturing art marble, after the aggregates and color have been mixed, the lower half of the form is filled with facing material mixed rather wet. The upper half is then filled with a dry-mix backing concrete. This absorbs excess water. The concrete is then compressed hydraulically and stored in the curing room where it remains for a period of three weeks in a constant temperature of 70 degrees. Steam is not used for curing because it was found that steam curing affects the color of the finished marble. The slabs are then put on a grinding table where the surface is smoothed and polished.

Color in Concrete

Raymond Wilson of the Portland Cement Association presented a paper describing the experiments made in the use of coloring pigments in concrete at the association laboratory. The paper described the tests made of the effect of exposure to light and air. Tests were made on about 2400 mortar discs colored with integral admixtures of 264 commercial pigments. Quantitative measurements of the color in these discs were made to determine the permanence of the coloring.

It was found that most of the pigments used are of a satisfactory degree of permanence after 6 months of exposure.

Wednesday Evening—Concrete in Architecture

Concrete in Architecture

Three of the papers presented in this session had reference to the architectural uses of concrete. The session was attended by members of the Illinois Chapter of the American Institute of Architects as well as by the delegates to the convention.

The first paper was presented by Frederick Lee Ackerman, a New York architect on "A Preliminary Note on Concrete Design—The Architectural Theory." The second paper, "The Use of Concrete on the Pacific Coast—Its Structural and Aesthetic Possibilities," was presented by John C. Austin, a Los Angeles architect. The third paper was presented by a Chicago architect, Irving Kane Pond, on "Architectural Uses of Concrete." The authors all stressed the importance of developing an architecture that utilizes the individuality of concrete as a building material rather than attempting to simulate other materials.

It is noteworthy in this connection that the honor awards for 1925 and 1926 granted by the Southern California Chapter of the A. I. A. include a large number of all-concrete buildings.

Behavior in Windstorms

"The Behavior of Engineering Structures in Recent Violent Wind Storms," was the title of a joint paper pre-

(Concluded on Page 48)

Building a Concrete Industrial Power House of Unusual Design

Difficult Location and Unstable Foundation Conditions
Necessitated Interesting Unusual Design—Built on Rein-
forced Concrete Mattress—Derrick Hoists Concrete for
Superstructure

By WILLIAM WREN HAY

DURING 1923, the International Motor Company, makers of Mack trucks, added over 100,000 square feet of manufacturing space to their motor plant at Plainfield, New Jersey, necessitating additional boiler capacity for heating. The existing boiler plant was overloaded and obsolete and it was decided to build a new boiler house and power plant where coal could be stored in large quantity, abandoning the old boiler plant.

The Plainfield plant occupies a lot only 200 feet wide between the main line tracks of the Central Railroad of New Jersey and a main highway, and is bisected by a spur track serving all buildings. The new power house was located at the westerly end of the plant buildings between the spur track and the railroad, thus limiting the depth to 79 feet between tracks. The location is such that a large yard storage of coal was secured, and unloading is done from both tracks.

Foundation Conditions

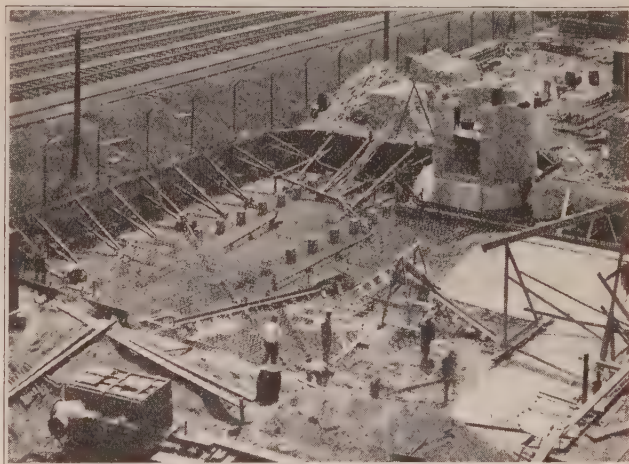
Foundation conditions were unstable. The soil was a fine sand, permeated by ground water to within two to three feet of track level, and when unconfined, somewhat of the nature of quicksand. In addition, diagonally across one corner of the selected site was a 48-inch diameter concrete pipe storm water drain. Owing to the necessity of providing additional steam for heating the new space when ready to be occupied, it was imperative to proceed with the foundations before the power equipment was selected and ordered and it was not possible to locate piles for footings without this very essential information. As a consequence, it was decided to place the entire structure on a reinforced concrete mattress, only the radial brick stack being supported on piles. This was a departure from power house arrangement as it places the basement floor on one level, with a difference in level between the boiler room floor and the floor of the turbine and switch-board room. The arrangement has proved very satisfactory from the operating view, and led to very considerable savings in construction due to reduced excavation, shoring, and pumping.

Previous experience had shown the soil to be capable of supporting distributed loadings of two tons per square foot. An investigation of the loads on the mattress showed an average load of only about 1600 lbs. per sq. ft., and as the center of gravity (pressure) of the loadings was very close to that of the mattress area, no practical difficulty was presented.

Design Features

The mattress has an extreme length between tracks of 80 ft. 6 in. and a width of 56 ft. 6 in. in front, being

74 ft. wide at the rear where extended to carry a 25-ton coal pocket, or an area of approximately 5000 sq. ft. The heaviest load carried is the 1500 k.w. turbo-generator and its foundation block, nearly 80 tons on an area 9 ft. by 17 ft. Fifteen load sections were investigated and the maximum moment was found to occur through one boiler setting and the turbine room with no load, almost in the center of the narrow width; the maximum soil load was found to be about 2000 lbs. per sq. ft. The depth, due to moment, was found to be 22 in., but for practical reasons this was increased to 24 inches. The top of the mattress



Constructing the concrete mattress that supports the entire building and power house equipment

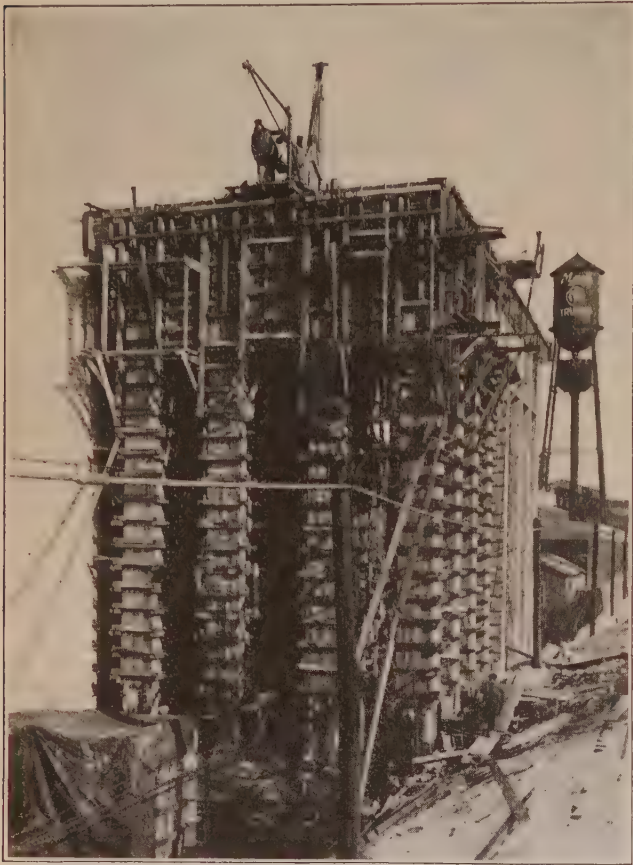
is reinforced throughout with $\frac{5}{8}$ -in. and $\frac{7}{8}$ -in. round rods two ways, spaced according to the moments found. It was waterproofed by the addition to the concrete of 2 lbs. of Toxement and although constantly under small pressure has always remained dry.

An interesting confirmation of the assumptions made in the design was afforded before the turbine foundation block was poured, while the boilers were operating. No reinforcing rods were run through the area covered by this block, and when the loads were unbalanced this way a small crack developed about midway the full length of this blank area, where the load section showed the maximum moment to occur without loading. As there was never any moisture visible in the crack, it can be assumed that this was tensile crack in the top.

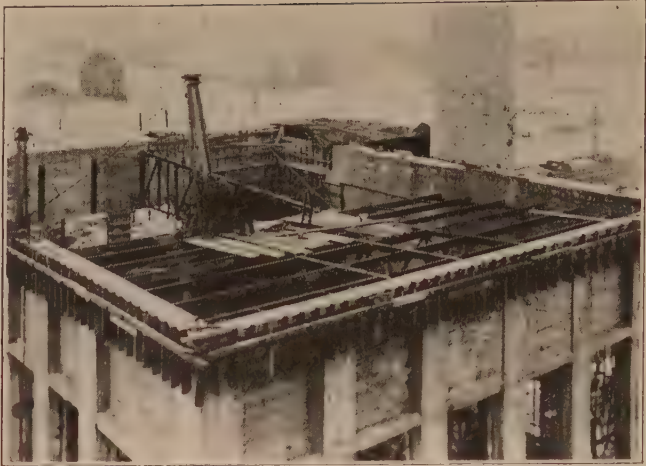
Design of Power House

The power house above the mattress consists of basement walls, pilasters, and spandrel top walls, with a cross-

wall supporting three columns and curtain brick wall between the boilers and turbine room. On an offset in the rear there is a reinforced concrete coal pocket, three sides of which are supported on the exterior pilasters and on the fourth side by two 14-in. square columns on spread



The superstructure consists of concrete pilasters and spandrel top walls, with a cross wall supporting three columns

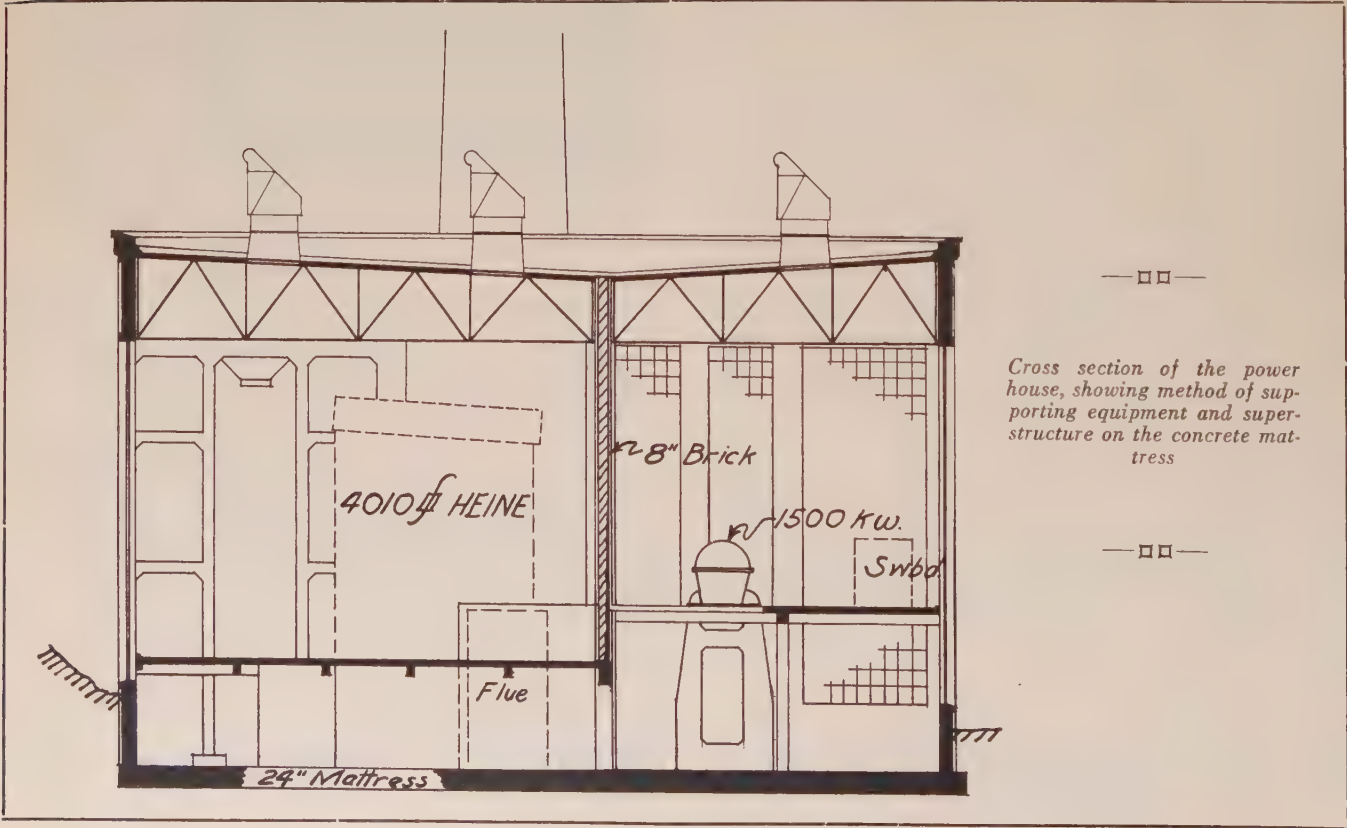


Showing the type of spandrel top walls used

footings bearing directly on the mattress. The roof is a poured-in-place gypsum slab, with asbestos sheet roofing, and supported on purlins and structural steel trusses that are face-bolted to the concrete. A large cooling tower rests directly on the roof trusses. Aside from the structural handicaps due to long spans and the concentrated loads of this cooling tower, the formwork for roof beams and girders would have made concrete more expensive than structural steel. The choice of roof slab was dictated by the light weight and by consideration of condensation. Ventilation is entirely natural, by fresh air inlet louvers in the basement walls and through large diameter ventilators in the roof.

One of the factors other than the unit prices influencing the choice of concrete for the exterior was the fact that the contractor for the factory additions had his concrete mixing plant in operation directly across the spur track from the power house site.¹ Several studies were made

¹"Concreting Under Restricted Conditions," CONCRETE, November, 1924, pages 169-171.



Cross section of the power house, showing method of supporting equipment and superstructure on the concrete mattress

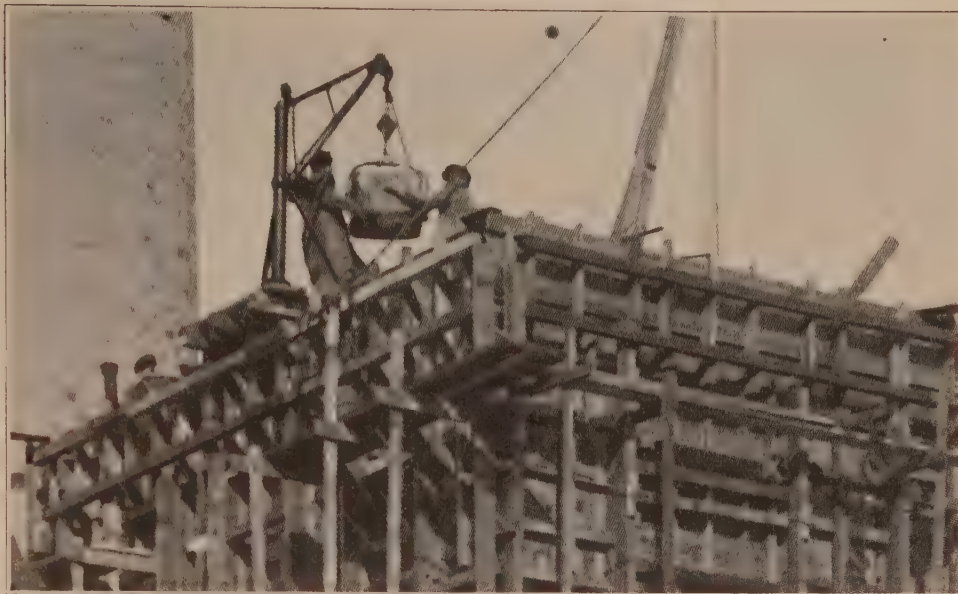
for the width and spacing of the pilasters, having in mind the use of standard units of factory type steel sash and provision for the equipment within, and as the longest elevation was fixed by the site depth and the height was

capacity, the buckets being swung over and dumped directly into the forms. The derrick was moved along the top as the form building progressed and considerable care was taken to have the buckets plumb with the derrick

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An unusually interesting and economical method of hoisting the concrete into place was adopted. Two self-dumping buckets, operating on a portable derrick hoisted the concrete to the top of the forms. The bucket was swung over the forms and the concrete dumped. The derrick was moved along the wall as concrete placing progressed

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set by the boilers, there were definite limits to the problem of subdividing this space to secure good proportion in the openings.

Construction Methods

The approach of winter weather, changes in personnel, and other conditions, made it mutually desirable for the owner to complete the work, consequently about two-thirds of the outside walls and all work other than concrete was done by the owner, using the contractor's men and plant. The total yardage of concrete above the base-

boom sheave when filling on the ground and to fill a full half batch.

The mixer was moved to a fixed position alongside the track so that aggregate was unloaded direct from cars when mixing, and two-wheel concrete cars were used between the mixer and the changing location of the hoist buckets. This change and insistence on hoisting and filling the buckets resulted in increasing a day's run of 5 hours concreting from 20 cu. yds. to nearly 36 cu. yds. with less men. At the time that concreting was finished, the cycle was so nearly automatic that by actual count 282 buckets of concrete were hoisted in five "mixer-hours," an average of 56 trips per hour for the gasoline hoisting engine. Concreting was carried on during the winter weather, taking only the usual precautions of heating water and aggregate, enclosing the forms with tarpaulins and heating with coke salamanders before and after concreting.

The arrival of the power equipment kept pace with construction so closely that it was expedient to use Lum-nite cement in about half the boiler setting so as not to delay unloading the boilers, and steam was on two days after the roofing was finished—in the remarkable short time of only seven months after the final decision was made as to type of boilers and fuel. The power house was designed by the writer and construction and installation was completed under his direction.



The building was complete in the remarkably short time of seven months

ment walls was only 350 cubic yards, and as this did not warrant the expense of a higher tower and additional spouting equipment, the large concrete plant was removed. Concreting was then carried on by the contractor using a one-bag mixer, with gangs of pails hoisted to walkways and carried to place. For this arrangement, two self-dumping contractor's buckets of 4 cu. ft. capacity were substituted, hoisted on a portable steel builder's derrick of 1000 lbs.

Sand and Concrete Tests Discussed in England

A lecture on the British laboratory aspect of portland cement concrete was delivered before the Manchester and District Clerk of Works Association of England by J. E. Worsdale recently. The lecturer dealt with certain simple tests which could be carried out on the job to determine whether materials were suitable for concrete. He discussed at length the organic test for sands, and also dealt very fully with the test for discovering the harmful effect of certain zinc compounds in spar. Certain types of spar have caused a considerable amount of trouble in the Manchester district.

Here and There

Some Random Notes on Visits With Concretors in the Field

CONCRETE invades every field. Not long ago we were rummaging around in a little book shop in New York's Greenwich Village. On one of the walls was a beautiful painting of a country landscape. The picture was unusually beautiful. It seemed to have more than the ordinary amount of "perspective"—whatever that is. At any rate, it impressed us so that we asked about it. Who painted it?

And here we got the surprise of our lives! The owner of the store was a pleasant fellow and seemed rather proud of his picture. So he held forth somewhat as follows:

"This is really an unusual picture. It is done in concrete! A young Hungarian painter here in the 'Village' has developed this new method of painting. He makes a paste of cement and water. Then he adds coloring material, puts the stuff on his palette and is ready to go. He can blend his colors just the same as if he working in oils. Instead of using a brush to put the 'paint' on the canvas, he uses his spatula and spreads the colored concrete. Also the canvas is really a piece of beaver board.

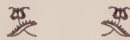
"The artist thinks there is a big field for work of that kind for mural decorations both in the interior and exterior walls of buildings."

Concrete in Art is now a fact! You can see the painting at Mr. Dacca's bookstore, at No. 4 Christopher Street, New York. If it hasn't been sold.



EVERYWHERE products manufacturers are concentrating on their marketing problems. This year will see a great deal of progress in the development of selling plans and advertising plans for concrete products manufacturers.

An article in this issue describes the recent merger of four Pittsburgh products companies and tells of their progressive plans for the future. At products conventions, too, the manufacturers are talking sales and marketing methods. Concrete products will be sold in 1927. Business principles apply to the products business just like they do to any other business and the products man cannot expect to sit in his office and sell in competition with other material interests that are aggressive in their sales work.



YOU want to be sure to read the Mixer Musings column on page 50 this month. Joe, the Mixer Boss, has started something that is sweeping the country!

A new organization has been formed—and the chances are ten to one that you are eligible for membership. The beauty of the thing is that it doesn't cost anything, even if you do get a lot out of it.

Who knows? Perhaps you can be the Grand High Truncated Cone!

It's an organization of—well, you turn to the Mixer Musings column and find out for yourself.

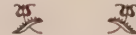
SOME manufacturers of concrete equipment have written in expressing their ideas on the matter of holding a cement show where all manufacturers of concrete equipment can exhibit their machinery. Such a show is not intended to replace the road show or to interfere with it in the least. It is merely to give manufacturers of equipment that does not logically fit in at the road show a chance to show what they have.

All opinions are not in yet, and if you haven't expressed yourself on this question, we would like to know what you think of it.



SOME contractors have been saying lately that they have been having difficulty buying the kind of aggregates they want. The objection was not so much the structural quality of the aggregates but the grading. The objection held for both fine and coarse aggregates.

With the present trend toward the design of concrete mixtures, the contractor wants aggregates that he can rely upon to be of a certain definite range in size and of a certain definite uniformity of size so that he can combine various sizes to get the combinations he wants.



IT is gratifying to hear an architect with the reputation enjoyed by Russell Barr Williamson of Milwaukee, say that concrete trim stone can now be specified by the architect with the assurance that the building on which it is to be used will look as good ten years after it is erected as when it is new. Seems as if the gospel of quality control that has been preached for so many years is bearing fruit.

It is logical to expect that the ornamentation of a building should be carried out in the same material that the structural frame is built of.



WE have heard a lot lately about the disadvantages of concrete as a structural material as compared with some other materials. One of the criticisms was that concrete depended for its quality on so many requirements, a variation in any one of which might result in poor construction.

Then along comes a release from the U. S. Department of Commerce that says: "Results of tests recently completed on full-sized steel columns at the Bureau of Standards show that, under present specifications differences in the physical properties of the material entering into sturdy columns produce a greater variation in the column strength than all the differences in type of construction." Also, ". . . The subject of column strength and method of design, especially in large sizes, is still a matter for so much discussion that the additional data which these tests have furnished will be of great value to engineers."

Can it be possible that there are other materials than concrete that need "quality control" and about which the last word in design theories has not yet been said?

Portland Cement in Concrete Engineering¹

Cement as a Factor in Quality Control of Concrete—The Problem of Portland Cement—Work Under Way at the Portland Cement Association Fellowship at the U. S. Bureau of Standards

By R. H. BOGUE²

TO the concrete engineer, portland cement is only one of a number of ingredients which together go to make up concrete. In addition to portland cement, there are added some forms of coarse aggregate such as pebbles, crushed rock, slag or other material; some form of fine aggregate such as sand or crushed rock or slag screenings, and water. Occasionally still other materials are added with the intent or hope of imparting some special property to the product. These are sometimes useful; sometimes not. Thus lime, gypsum, cellite, trass, puzzolana, ground slag, calcium chloride and various other materials have found their way into concrete.

Many of these materials are not definitely standard. Almost every kind of igneous and sedimentary rock has been used as coarse and as fine aggregate. The quality and purity of the admixtures varies over a wide range. The water used contains whatever salts happen to be present in the local supply, and even sea water has been used. Of all of the materials that go into concrete, the portland cement is probably the most constant.

Engineering Research on Materials

It is not surprising that the engineer who is responsible for the making of concrete has concerned himself primarily with such factors as are most variable, and as he can most effectively control. It was learned a great many years ago that soft and easily friable or unsound stone, used as aggregate material, imparted an element of uncertainty and probable weakness to the concrete. It has long been recognized that the ratio of the fine to the coarse aggregate could not vary over too great a range without grave danger to the permanence or resistance of the concrete. The seriousness of too much water in mortars was known even to Vicat. In 1818 this pioneer in research on mortars wrote:³

"The whole secret of good manipulation and right employ is condensed in the following precept: 'Stiff mortar and materials soaked.' Our bricklayers, on the contrary, seem to have taken for their motto: 'Dry bricks and drowned mortar.'"

Throughout a great part of the period during which portland cement has been manufactured, serious-minded investigators have recognized the problems of correct proportioning, of intimacy of mixture, of fineness of grinding and of water ratio as of prime importance. But

it has been left to the progressive engineers of the present generation to discover and apply the laws which control these important factors.

This has been done within the last few years and as a consequence these laws are only now being tested on large scale operations and are only now being incorporated into general practice in concrete construction. The extreme importance attached to such problems has caused the engineer to devote his attention, up to the present time, almost exclusively upon the mechanical features of concrete engineering.

100% Efficiency

But this is an age of advancement. The cry for new knowledge is in the air. President Coolidge has emphasized repeatedly the consciousness which is growing within us that no matter how satisfactory the present may appear, we must hold our eye to an even higher level of attainment in our striving for the ultimate perfection. As he put it:⁴

"The hope of tomorrow lies in the development of the instruments of today. The prospect for advancement lies in maintaining those conditions which have stimulated invention and industry and commerce. The only road to a more progressive age lies in perfecting the instrumentalities of this age."

Questions are being asked now in all seriousness which a few years ago would have been regarded as absurd because unanswerable. The solution of the age-old problem of correct proportioning has led to a thirst for further progress in whatsoever manner might be necessary toward the goal of one hundred per cent efficiency for the structures of tomorrow.

This does not mean that the accomplishments of today are poor or even that they are not entirely satisfactory in a great proportion of cases. On the contrary, as has been pointed out at the sessions of this Institute, the user of concrete is able today to build with greater assurance of entire satisfaction than ever before in history. This is brought about largely by an understanding of the laws of correct design.

Now this is the point I wish to emphasize. It is within our very present experience that we have learned the importance of conforming to the laws of scientific control in making concrete. We are very conscious of the reality of the benefits obtained by following those laws. All of this brings us to the belief that an unravelling of the laws governing the constitution of cement clinker and the behavior of the constituents of cement when made into concrete may hold developments which today can only be sensed but not definitely apprehended. In the history of the in-

¹ Published by permission of the Director of the National Bureau of the U. S. Department of Commerce, and presented before the 1927 meeting of the American Concrete Institute. Paper No. 9 of the Portland Cement Association Fellowship at the Bureau of Standards.

² Research Director of the Portland Cement Association Fellowship at the Bureau of Standards. This fellowship consists of a staff of physical chemists, physicists and petrographers conducting research on portland cement under the joint support of the Portland Cement Association and the National Bureau of Standards.

³ "A practical and scientific treatise on calcareous mortars and cements, artificial and natural," translated by J. T. Smith, 1837, p. 94.

⁴ Address before Amherst College Alumni, Boston, 1916.

dustry there are cases too numerous to count wherein additional scientific knowledge has given to that industry, or to some part of it, some measure of added strength. It may have taken the form of substituting an intelligent and certain control of operation for an unintelligent or uncertain rule-of-thumb control. It may have resulted in some change in the procedure which affected the cost of operation, or the composition limits of available raw materials, or the rate of production, or the quality of the finished product, or the market, or the proper utilization of the product. Just in what department our investigations will prove to be of greatest value, we do not know, but we are convinced that scientific information on the nature of the compounds of clinker, and the reactions of these compounds, holds promise of application in many directions. Perhaps the eventual direct application may be in manufacture, in raw material, in control, or it may be in the utilization of cement in concrete. But a benefit in one department is reflected into all of the other departments. An improvement in any branch of manufacture means also an advantage in the final concrete.

This is one of our ambitions; one of the reasons for our existence. The other is to extend the field of usefulness of concrete by the development of a material which will possess to a higher degree the virtuous qualities for which concrete is now well known. Or even, perhaps, to go beyond these to the opening up of possibilities in construction, or art, or industry which are not yet conceived. In the case of many commodities, supply follows the demand, but in the case of the new discoveries of science, a market is born where none existed and the creation of the product opens to reality trails of progress, of achievement, which formerly were lighted only by the Aladdin's Lamp of Imagination.

The Problem of Portland Cement

Our problem, therefore, is how most effectively, most directly, to project our experimentation to the accomplishment of these ends. Much research has been undertaken on portland cement (see Paper No. 3 below) but, with a few notable exceptions, these investigations have contributed little to the solution of the fundamental problems of constitution and behavior. The experimentation has been conscientiously undertaken but has been inadequate for important generalizations. Thus the behavior of a given cement, or a number of cements, when subjected to a given set of conditions may be of importance, but it cannot suffice for such generalizations as will affect the industry as a whole. A discovery of the laws which govern the relation between constitution and cement value can be made only with the pure materials and the employment of the most refined methods of physico-chemical measurements.

In the few exceptions referred to above, this condition has been appreciated. The contributions of Rankin and his associates at the Geophysical Laboratory, and of Bates and his assistants at the Bureau of Standards have opened the way to the comprehensive studies which we are pursuing.

It was obvious at the start that any superficial "tests" which we could make would be quite useless as a means to attain the end we had in mind. The processes of setting and hardening of cement are due essentially to chemical reactions, but these may be very complicated. Cement contains a number of constituent compounds and each (presumably) of these reacts with water. In one type of reaction these compounds form a basic material, as hydrated lime, and other compounds less basic than were present before water was added. In another type of reaction water adds directly to the compounds. But there are

other reactions to complicate the process. Some of the hydration or hydrolysis products may interact; the gypsum in the cement may react with some of the other components; the salts in the mixing water or in the water which later may come in contact with the concrete may bring about other changes. And finally, on exposure to air, the carbon dioxide may further alter the reaction products.

I have indicated that all of these chemical changes are brought about between the compounds in the cement on the one hand, and the water, dissolved salts or air, on the other hand. It is necessary to study these reactions if we are to learn the nature of the setting and hardening processes, and these processes must be well understood if we are to learn why they do not always proceed in the usual or desired manner. But we cannot study these reactions except we prepare the several compounds of cement in the pure form, and investigate the nature and rate of each reaction under ideal conditions. And finally we cannot prepare these pure compounds except we know what they are.

That, then, becomes our starting point; to find out just what portland cement consists of, the compounds which are in it, the limiting ratios of these constituents. We must know the influence of each material in the raw mixture upon the reactions occurring in the kiln, for each material exerts its special and characteristic influence in the production of the several product compounds.

So that problem oscillates from one phase to another, and the findings on any one part affect every other part of the study. A program as comprehensive as this cannot be covered in any brief period; nor can results of immediate application to the engineer be evolved in such a period. And of the results which will be obtained, while in some cases they may be applied in the field by the engineer, more often they must be applied in the manufacture.

Progress in Cement Research

For two and a half years our staff in Washington has engaged in this study. This group of chemists, physicists and petrographers has, in that time, reported the virtual completion of about twenty separate problems, and eight papers have been published in the scientific and technical press. But in spite of this progress, the study has only begun. Many problems of technique have been worked out; many problems identical to the major investigation have of necessity been attacked as their solution was essential before progress could be made.

This is not the place to go into a detailed account of our researches. For those I refer you to our several publications.⁵ It will not be out of place, however, and may be of interest to you, for me to describe in a general way some of the studies that we are following and some of the interesting results that we are obtaining.

Of fundamental importance above all others, and for the reason given above, are the studies which will give us information on the nature of the constituents in clinker.

⁵ Paper No. 1, "Studies on the System $\text{CaO-Fe}_2\text{O}_3\text{-SiO}_2$," by W. C. Hansen and R. H. Bogue, *J. Am. Chem. Soc.*, 48 (1926), 1261.

Paper No. 2, "The Determination of Uncombined Lime in Portland Cement," by Wm. Lerch and R. H. Bogue, *Ind. Eng. Chem.*, 18 (1926), 739.

Paper No. 3, "A Digest of the Literature on the Constitution of Portland Cement Clinker," by R. H. Bogue, *Concrete*, July, 1926, to February, 1927.

Paper No. 4, "Portland Cement Research," by R. H. Bogue, *Proc. A. S. T. M.*, 26 (1926).

Paper No. 5, "The Preparation and Optical Properties of Calcium Hydroxide Crystals," by F. W. Ashton and Raymond Wilson (in press).

Paper No. 6, "Studies on the System $\text{CaO-Al}_2\text{O}_3\text{-SiO}_2$. The Composition $8\text{CaO-Al}_2\text{O}_3\text{-2SiO}_2$," by W. C. Hansen, W. Dyckerhoff, F. W. Ashton, and R. H. Bogue (in press).

Paper No. 7, "The Preparation of Optically Clear Selenium for Use in Index Media," by L. T. Brownmiller (in press).

Paper No. 8, "X-Ray Diffraction Measurements on Some of the Pure Compounds of Portland Cement," by E. A. Harrington (in press).

Some of these have been known for some time. Others have been guessed at, but the guesses of the various authorities do not always agree. One group believes that a complex compound containing lime, alumina and silica is present in clinker; another group, that lime and one of the silicates form a loosely bound compound known as a solid solution; and still another group, that the lime and silica form two separate compounds. Work in our laboratory led us to the latter belief, and this was corroborated by other authorities in this country. A recent co-operative study in our laboratory with a distinguished European scientist who formerly differed from us in this matter has been completed and is now in press. It is under joint authorship with him and bears testimony to the fruitfulness of co-operation.

But other components than lime and silica are present, and we must learn the manner of their combination. Into what compounds do the alumina, the iron oxide and the magnesia go? What change is observed in the composition of the product resulting from the use of different percentages of these and still other constituents of the raw material? These questions are being studied and two or three reports on this aspect of our work have been published.

It does not suffice, however, to learn only the influence of the several constituents on the composition of the product. In order that this information may be of significance to us, we must observe the corresponding influence on the cement value of the product. Different technique are required for these two lines of investigation. There are mechanical difficulties in the construction of a furnace which can be used to obtain data on constitution and at the same time yield a sufficient quantity of product to give us data on cement value. In a furnace which enables us accurately to determine the nature of the compounds formed, and the changes in these at varying composition of the raw mixture, we obtain temperatures up to 1625 deg. C. (2957 deg. F.) and control them to 1 deg., but the charge is only a fraction of a gram. A second furnace was built for obtaining a larger quantity of product so that tests could be made on strength and resistance to corrosion. In the latter furnace, temperatures up to 1550 deg. C. (2822 deg. F.) are obtained, controlled to 10 deg., and about two pounds of product are obtained per day. In both of these, contamination is completely prevented by the use of platinum containers for the charges and the employment of the electric current as the source of heat.

In these experiments, iron oxide is substituted systematically for alumina; magnesia or alkalies for lime; and so on with several other minor constituents. The effect of such substitutions is noted on the temperature of burning, the completeness of combination, and the strength under compression of 1-inch cubes at various ages. A number of tests are added to give information on the setting and hardening and resistance to corrosion.

No ideal in manufacture can be considered entirely apart from the significance it bears to the production of concrete. I have referred to the numerous reactions of the setting and hardening processes. In order to learn more about these, several compounds which may occur in portland cement have been prepared in the pure form. These pure compounds have been made up into 1-inch cubes with sand and water, and submerged for various periods in water and in salt solutions. Reference may be found in the literature to a number of researches where concrete blocks have been made the object of somewhat similar studies. In these latter, the aggregate, the cement-water ratio and various additional materials have been varied to determine what technique or combinations gave the most resistant product. But in our tests it is only the com-

pound or mixture of compounds which changes. Hence we may observe not only the physical effect in each case, but the nature and the rate of the chemical reactions, the nature of the end-products, and the effect of each reaction or end-product on the strength and appearance of each compound. Some of the compounds are found in this way to be resistant; some, non-resistant. The substitution of certain compounds for others, or a change in the ratio of those already present, has been found to alter profoundly the strength of a mortar or its resistance to certain types of corrosion.

A New Compound

To demonstrate the connection between the several studies, I may point to one instance. A certain substitution in a particular mixture with which we were working was found to result in the formation of a new compound. The formation of this compound during the burning lowered the required temperature and made for more complete combination of the lime. Strength tests indicated a probable advantage as a result of the substitution, and finally this same substitution gave a product which seemed to be more resistant to the corrosive action of sulphate waters. Here, then, is a specific finding that looks most interesting. However, much more work is required before any definite application can be made.

Still another phase of our work which must be mentioned is the identification of the compounds which are produced in our furnaces, in commercial clinker, and in the reactions of setting and hardening. For this purpose the polarizing microscope is indispensable. Without it a correct interpretation of much of the work described would probably be impossible. Chemical analysis indicates ultimate composition but does not reveal the exact combinations of the elements or oxides that are present. These compounds may be determined, however, by a painstaking examination of the optical properties as determined under a microscope. In the case of new compounds these have first to be prepared in pure form, and their optical properties definitely ascertained. In no other manner that we know of could we as satisfactorily identify the compounds with which we are constantly working. In some very special cases, however, the microscope fails, and in these cases we are employing the x-ray diffraction method of examination. This is a relatively new tool, but in some instances will give us desired information where the microscope will not do so, and in other cases may be used to corroborate important findings.

Summary and Conclusions

I have given to you in this brief space some of our ideas on the study of portland cement in concrete engineering. I have indicated the nature of engineering research on the proportioning of the constituent materials that go to make up concrete, and have emphasized the remarkable achievements of the engineer toward the elimination of unsatisfactory concrete; toward the production of a concrete which is perfect in the great majority of cases.

But this age is one which looks ever to new conquests of achievement; to new levels of perfection. Progressive industry cannot stand still. It cannot rest on its laurels. It must advance. Nothing less than ultimate perfection can be our goal, but 100% efficiency under the standards of today may be far below the line under the standards of tomorrow. Our purpose, then, is to narrow the margin between the high-water mark of efficiency and the 100% line, and likewise ever to raise our ideas of perfection by the evolution of new and higher standards of value.

We are still in the preliminary stage of our research, but it is not impermissible to look ahead. We have been

obliged to develop methods that would be comprehensive and adequate; we have had to build apparatus that would meet our extraordinary requirements; we have had to organize a new technique in highly specialized physico-chemical and optical measurements; we have had to meet unusual conditions by the discovery of causes, the invention of means for removing these causes, and the proper adaptation of those principles of our materials. Numerous incidental problems require solution before progress can be made on the major investigations. However, many of these latter are now well under way and the light we are receiving leads us to greater confidence in the reality of our goal.

But ultimate application of these researches can be made in safety and in confidence only after they have passed from the laboratory to the industrial plant, and in every case assurance must be had that any prospective change in manufacture shall be to the direct advantage of the final concrete. Such assurance cannot be obtained in a day or a year. The element of time is very significant where the question of permanency is vital, as in concrete. But we may look forward to changes in portland cement which, in one department or another, will increase its usefulness. It may be found possible, for example, to give a product which, as concrete, will be more resistant to the action of corrosive water, either acidic or alkaline or charged with such salts as sulphates or magnesium compounds. It may be found possible to improve the true early strength, or to diminish the volume change in setting or to improve plasticity for mortars, or to widen the field of usefulness. Any one of these would make the study very much worth while. The biggest mistake we could make, however, would be to rush through an idea that had not been checked and confirmed and tested throughout all the long range of influences which might be effected by its adoption.

A part of our program of research has been described and a few of our experimental results have been mentioned. Some of the difficulties and necessary refinements in our technique have been referred to, as well as some of the unusual equipment which has been constructed and employed. We are in the midst of a program of fundamental research on portland cement which is broader in scope than any that has ever before been undertaken. We are obtaining results which are both interesting and important. What ultimate effect these may have on concrete engineering is impossible to say. But it is certain that they will have some influence, and it is equally certain that this influence will be in the direction of an even more useful product—a more universally perfect concrete.

Cinder Concrete Products Men Convene in Philadelphia

Cinder concrete manufacturers from all over the country celebrated the fourth annual gathering of their association at a convention at the Benjamin Franklin Hotel in Philadelphia, Pa., recently. Charles P. Minning of Baltimore was elected president of the association for the coming year.

Leroy A. Goodwin, past president of the association, delivered the address of welcome to the visiting delegates, representing 78 plants.

Two of the addresses delivered were made by a representative of the Philadelphia Building Department and the district representative of the Portland Cement Association.

A bright spot of the banquet was supplied by Francis J. Straub with an exhibition of magic and a running comment of witty remarks.

Pipe Manufacturers Hold Their Sessions in Chicago

The annual convention of the American Concrete Pipe Association, held at Chicago, Illinois, at the Palmer House, on February 21 and 22, had the largest registration in the history of the organization.

New Officers

Mr. R. A. Foley, general manager of the Superior Products Company, Detroit, Michigan, was elected president, and Ernest F. Bent, president of the Bent Concrete Pipe Company, Los Angeles, California, H. F. Ahrens, Jr., treasurer of the Lock Joint Pipe Company, Ampere, New Jersey, and C. F. Buente, secretary of the Concrete Products Company of America, vice-presidents.

In addition to the regular business of the association, a number of papers were presented and a discussion of numerous subjects pertaining to the manufacture of concrete pipe followed. Of special interest was an illustrated talk by Mr. C. F. Buente, on the jacking of a 60-inch concrete pipe through a railroad fill. This work was necessitated by a concrete pipe sewer having to pass under four tracks of the P. & L. E. R. R., a branch of the New York Central. Very little trouble was experienced in jacking 80 feet of this pipe through the railroad fill. Inspection after the job was completed showed perfect alignment and no damage to the joints.

Papers Presented

A paper on "Pipe Testing Equipment and Commercial Laboratory Inspection," was presented by N. A. Eppes, president of the Gulf Coast Concrete Pipe Co., Houston, Texas. This was of added interest since a number of members of the pipe association during 1926 made and furnished specimens of pipe of different sizes and with different areas of reinforcing for testing purposes, to assist the Joint Concrete Culvert Pipe Committee in the work of preparing national specifications.

Manufacturing and marketing methods used in eastern Michigan were the subject of a talk by C. E. Edwards, of the Lamar Pipe and Tile Company, Grand Rapids, Michigan.

The second-day afternoon session consisted of much general discussion, with Ernest F. Bent presiding. Promotion methods, quality control, and plant inspection by the association were talked of. "Should plain concrete pipe be manufactured above twenty-four inches in diameter?" was another subject.

Reports were presented at this session on general and special conditions, by manufacturers from different sections of the United States and Canada.

Social

The annual dinner was held the evening of the second day of the convention, with entertainment for the ladies arranged specially by Mrs. C. H. Bullen.

London's Largest Factory to Be of Colored Concrete

Specially constructed towers are to be built to expedite work on a huge £500,000 (\$2,500,000) tobacco factory in Egyptian style, which is to be erected in London. Sir Robert McAlpine & Sons, contractors of the Wembley Exposition, which contained the largest reinforced concrete buildings in the world, have been entrusted with the contract, amounting to over £500,000, for the construction of this new factory for Carreras, Ltd., cigarette and tobacco manufacturers, in northwest London.

General Contractors Discuss Vital Problems at Asheville

Thoughtful Discussions of a Wide Variety of Contracting Problems Featured the Sessions of the Associated General Contractors of America at Their Eighth Annual Meeting at Asheville, N. C.

FROM January 24 to 27, inclusive, an earnest group of men met at the Battery Park Hotel at Asheville, N. C., to talk over the many problems that are vital to the success of the general contractor. More than 500 general contractors from every section of the nation were present.

There are many things to discuss in an industry so complex as this. All contractors have individual rights and interests but they must be coordinated for the general good. How these varying interests can be adapted for the benefit of the industry as a whole, was the keynote of the discussion. Of course, there were differences of opinion. But the discussions were all entered into a most tolerant spirit, even when differences of opinion were very marked. These contractors knew that if they were going to think through their problems, it would be necessary to discuss them from all points of view.

Among the high lights of the convention were discussions of these problems: The contractor's sales problem; accident prevention; day labor; surety bonding and lien laws.

The Contractor's Sales Problem

The general contractor, like every other business man, has a sales problem. Industry everywhere is now in the merchandising era. Approaching the problem of "Price vs. Service in Construction" from this angle, Col. W. T. Chevalier, Business Manager of Engineering News Record, told of the changing status of the contractor as a seller of construction service.

In the past, the contractor has been concentrating on production problems and has overlooked the importance of selling himself and his work. He is the only business man that is selling *price* rather than *service*. Under the old system of awarding contracts, price was the only consideration, but already the buyer of the contractor's services is recognizing that the low bid is not the only basis upon which a contract should be awarded.

The trend of selling in all business now is away from price and toward value. The contractor also, must develop the merchandising instinct as other industries have done. How the contractor will work out the details of this problem will be a matter for the Association to solve. With it are many related problems, all of which must be considered.

Accident Prevention

With this idea of better merchandising as the opening thought, the convention turned to other problems. One of the most important of these was accident prevention in the construction industry. W. F. Austin of Detroit submitted a proposed manual of accident prevention for the construction industry. He said that even indirect losses outside of insurance reductions due to accidents total more than the cost of accident prevention. Contractors in

the past have been considering accident prevention work too much as a separate activity when in reality it is an integral part of operating costs.

The accident record of the construction industry is not a favorable one when compared to other manufacturing industries. It has been proven on some jobs where this matter has been given attention that accidents can be reduced. Some big jobs have had very favorable records.

The presentation of the tentative manual of accident prevention is only one step in the program for reduction of accidents. This is to be one of the Association's major activities during 1927. A gift of \$5,000 by the W. E. Wood Co., contractors of Detroit, will help to carry on this work. It was proposed that an accident prevention expert be employed by the Association to suggest methods of reducing accidents to the members. In the discussion, Mr. Tubesing of Milwaukee offered to present a cup to that member of the Association that would finish 1927 with the best accident record for the year. It was also suggested that the local chapters organize accident prevention committees and, if possible, employ men to reduce accidents among the members of the chapter.

Contract Bonding

More time was given to the question of bonding than to any other subject discussed at the convention. There were talks by leading surety men, presenting their side of the question. These were followed by discussions of a set of questions prepared by members of the Associated General Contractors who had given the matter careful consideration. A way to solve the differences of opinion may be opened by a conference which is to be held by bonding men in New York in the near future. Two entire sessions of the meeting were devoted to discussions of this important feature of contract awards.

The committee declared that the promiscuous issuance of surety bonds and the misuse of lien law provisions are largely responsible in permitting incompetent bidders from entering upon construction operations.

"Without the assistance of underwriters, who make it possible for incompetents and plain crooks to qualify for contracts which they cannot possibly perform, those irresponsibles who constantly bring discredit to the construction industry would disappear from public construction.

"It is common experience that irresponsible material dealers deliver building materials to these incapable bidders without making a semblance of credit investigation, knowing that the average home owner is not familiar with lien law provisions and cannot protect himself against dual payment if the intervening purchaser fails to pay."

Other Discussions

Quantity surveying, its merits and its drawbacks, came in for an enthusiastic discussion. Many of the local

chapters of the Association have organized quantity survey bureaus and most of the members are emphatic in their praises of this work. Representatives from the various chapters told of their experiences with the quantity survey, and described the methods of operation and payment in force in their chapters.

The subject of group buying was discussed by several speakers, and the possible advantages of this method were presented for the consideration of the contractors. The effect on local business and local dealers was considered as a drawback to centralized group buying.

The old question of day labor vs. contract was not forgotten. It took the shape of a discussion of the entry of municipalities and governments into the construction industry. A resolution, recommending that the Associated General Contractors foster a Federal bill limiting day labor operations of Government Bureaus and that similar bills be introduced into the various state legislatures, was adopted.

The five-day week was also denounced by the convention and a resolution was adopted urging the various chapters to resist its establishment.

Future Activities

The convention was an extremely friendly one. A stranger was not a stranger very long. There was an unusual amount of visiting and the spirit of friendliness and helpfulness that goes a long way to make a convention a success was evident everywhere.

In this, its eighth annual meeting, the Association did not talk only of the things it hoped to accomplish. Much had already been done and the officers were able to report definite accomplishments as well as to discuss future activities. The Associated General Contractors are doing a very worthwhile work in an efficient manner. There is much still to be done and there is a real need for additional funds. In order to carry on its work properly, the organization needs a larger staff. If the funds are available during 1927, it is proposed to employ a quantity survey expert to establish local survey bureaus, a man to compile information and statistics on day labor and force account activities and a man to devote all his time to accident prevention work.

The Constitution of Portland Cement Clinker

By R. H. BOGUE

ADDENDUM

Since the series of articles on the "Constitution of Portland Cement Clinker" that was concluded in the February issue went to press, Dr. Dyckerhoff has spent two months in research with the staff of the Portland Cement Association Fellowship at the Bureau of Standards in Washington. During this period an intensive study was concluded on the composition $8\text{CaO} + \text{Al}_2\text{O}_3 + 2\text{SiO}_2$, as a result of which Dr. Dyckerhoff has accepted the non-existence of a compound of that composition. The crystalline material which previously he had believed to be $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{SiO}_2$ was found to be $3\text{CaO} \cdot \text{SiO}_2$. A paper presenting the results of this investigation will be published shortly under joint authorship with Dr. Dyckerhoff and members of the staff of the Portland Cement Association Fellowship.

Architects' Opinion and Marketing Discussed by Products Men

Sensing the forward trend of the importance of definite marketing methods and of considering the architects' viewpoint, the recent Wisconsin State Products Association convention gave the larger part of its time to these two subjects. The meeting took place at the Pfister Hotel, Milwaukee, Wis., on February 3 and 4.

Cornelius Corcoran, president of the City Council, opened the gathering with the address of welcome. In response, Mr. C. O. Gochnauer, president of the association, laid considerable stress on the fact that the major problem before the industry today was that of selling its product rather than of producing it.

Mr. Gochnauer's response was followed by a talk on the architects' opinion of concrete products by Russell Barr Williamson, well-known Milwaukee architect. Mr. Williamson stated that in his opinion there was very little doubt that concrete was the building material of the future, and that it would sooner or later take its place in the architect's mind alongside of limestone, granite and marble. That the difficulty which was sometimes experienced in securing the enthusiastic co-operation of architects in the use of concrete was due to the fact that in the past concrete products has not always been of a definite quality, was one of the thoughts expressed.

Mr. Williamson's talk was followed by an informal speech by the Testing Engineer of the University of Wisconsin. He stated that less than \$2,000 worth of block testing annually was done in the university laboratory and that he believed more should be made.

After a short talk on mortar by Mr. Winkler of the Portland Cement Association, W. D. M. Allan, Manager of the Cement Products Bureau of the Portland Cement Association spoke on the merchandising of concrete products. Mr. Allan called attention to these significant facts: That the wall volume of concrete building units produced in 1926 was ahead of that of the brick industry for the same year, that continued increase of sales against the competition of rival products will require real sales ability on the part of products men, and that an aggressive sales policy and a lower price for block, have been made necessary.

An interesting instance of a sales policy was discussed by Mr. Allan in telling of conditions in the products industry in New Jersey. In one community which he did not name he stated that six years ago there were ten plants turning out about 300,000 blocks per year. This condition continued at the same rate for three years, when a cinder products plant came into the field. The cinder plant sold over one million blocks the first year, and at the end of the third year was selling about five million blocks annually. Production of the other ten plants continued on the former level of 300,000 blocks per year. Mr. Allan stated that the program of the Concrete Products Bureau looks to a production of 1,200,000 8x8x16 block in 1930, almost equaling the combined production in terms of wall volume of the brick industry and the clay tile industry.

You will be interested in the announcement carried in the Mixer Musings column on page 50 in this issue.

Concrete Manhole and Catch Basin Block

An Important New Market for the Products Manufacturer—Types of Block Used—Specifications—Tests—Design and Construction of Concrete Block Manholes—Advantages

For many years concrete manhole and catch basin block have been used to a limited extent, while engineers, builders and the public generally seemed to remain quite unaware of the obvious advantages and quite evident economies offered by this material. Recently, however, the conspicuous success of concrete block manholes and catch basins in Chicago and its suburbs, Duluth, Minn., Terre Haute, Ind., Waukesha, Wis., Waterloo, Ia., Fribault, Minn., and a number of other cities of the middle west has attracted wide attention. Many other communities throughout the country now using competing materials exclusively are investigating the possibilities of this type and with this fact in view a description of the block and the methods employed in the midwest should be of especial interest at this time.

CONCRETE block used in manhole and catch basin construction are circumferential units usually manufactured in lengths of 16, 18 or 22 inches. The 16-inch units are made in thicknesses of 5 and 6 inches and height of $5\frac{3}{4}$ inches, giving 6-inch courses. The $16 \times 5\frac{3}{4}$ -inch block, 5 inches thick, weighs 26 to 27 pounds and in the 6-inch thickness weighs 32 to 33 pounds. Nine block are required to the course for 36-inch diameter manholes and 12 block to the course for 48-inch diameter manholes.

Probably more of the 18-inch block are being manufactured than of any other kind. These block are $7\frac{3}{4}$ inches in height, giving courses 8 inches high. They are commonly made in thicknesses of 5 and 6 inches and occasionally in 4-inch thickness. In the 5-inch thickness the block weighs about 48 pounds and in the 6-inch thick-

ness about 58 pounds. A course of 5 block gives an inside diameter of 30 inches; 6 block give a diameter of 36 inches; 7 block a diameter of 42 inches and 8 block a diameter of 48 inches. About 18 to 20 block of 5 inches thickness are made to the sack of cement.

There is also in use in a few localities a block which is 22 inches long and $7\frac{3}{4}$ inches high, made in thicknesses of 4, 5 and 6 inches. This is undoubtedly just as good a



A special block, providing for intakes, is shown on end

block so far as the quality of the work produced is concerned but the larger and heavier units are not as handy to lay.

The common run of catch basin and manhole work calls for 48-inch diameter and all of the blocks are molded to a radius of 24 inches. Sufficient adjustment is provided in the joints to enable these blocks to be used on work of small diameter without difficulty. The 5-inch thickness is standard for all purposes in Chicago and some other cities, although the 6-inch thickness is required in a number of cities for street and other public and industrial work. While the 5-inch block is commonly used for residential work, the 4-inch thickness has been used to some extent and found sufficient for this class of construction in suburban communities.

Description of Manhole Block

All block employed for these purposes are solid, having no air spaces. The upper surface of the block is usually grooved or finished with a rough texture to clinch the



Tapered block are used for the upper courses

mortar. The latter should be spread over the entire top surface of the block so that on compression from the weight of the block above an effective water stop is produced. The 18 by 7 $\frac{3}{4}$ -inch block are formed with tongue and grooved ends, while the 16 by 5 $\frac{3}{4}$ -inch block have both ends grooved, the vertical spaces formed by these grooves being filled with mortar.

Tentative specifications for concrete catch basin and manhole block, based on successful local practice in a number of cities have been prepared recently by Committee P-1, American Concrete Institute. These are represented in somewhat condensed form in the following:

Condensed Specifications for Concrete Manhole and Basin Block

The ultimate compressive strength of solid concrete manhole and basin block at 28 days of age or when delivered upon construction work must average not less than 1,500 lb. per sq. in. of cross-sectional area of the unit as laid in the wall. No individual unit shall test less than 1,200 lb. per sq. in. of cross-sectional area under the same conditions.



A concrete block manhole completed and ready for backfilling

Concrete manhole and catch basin block shall not absorb more than 8 per cent of the dry weight of the unit when tested as hereinafter specified.

Specimens for tests shall be representative of the commercial product of the plant. Not less than three and preferably five specimens shall be required for each test. Specimens used in the absorption test may be used for the strength test.

Absorption Test

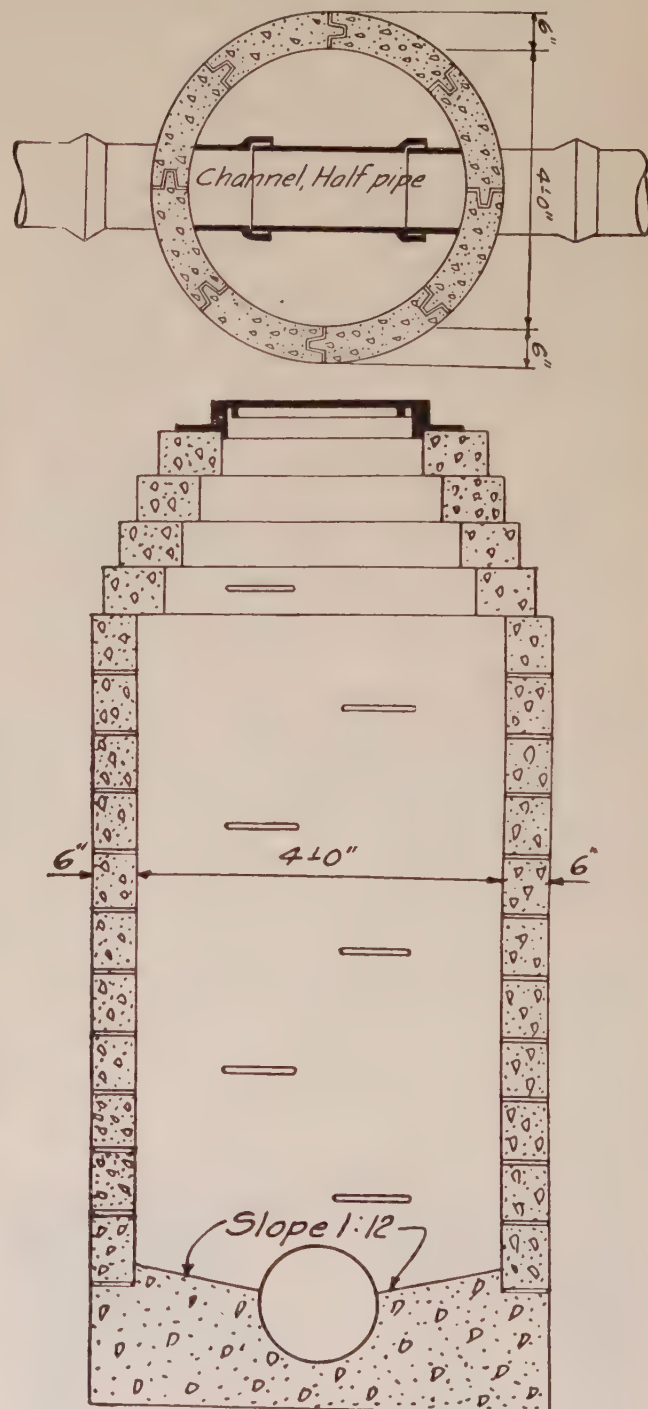
The specimens shall be immersed in clean water at approximately 70° F. for a period of 24 hours. They shall then be removed, the surface water wiped off, and the specimens weighed. Specimens shall be dried to a constant weight at a temperature of from 212° to 250° F.

and reweighed. Absorption is the difference in weight divided by the weight of the dry specimens and multiplied by 100.

Strength Test

Specimens for the strength test shall be dried to constant weight at a temperature of from 212° to 250° and shall be carefully measured for overall dimensions of length, width and height.

Bearing surfaces shall be made plane by capping with



Plan and section of concrete block manhole and catchbasin as used in Terre Haute, Ind.

plaster of paris or a mixture of portland cement and plaster which shall be allowed to thoroughly harden (from 3 to 6 hours) before the test. No point on the surface shall deviate from the plane more than .003 inch. The

cap shall not be thicker than $\frac{1}{8}$ -inch and shall be formed by means of a cast iron or steel plate which has been machined to a true surface.

Specimens shall be accurately centered in the testing machine and the load applied through a spherical bearing block placed on top of the specimen. The rate of loading after 50 per cent of the ultimate load has been applied shall be not greater than that which will produce a shortening of the specimen of .02 inch per minute.

The specimen shall be loaded to failure. The compressive strength in pounds per square inch of gross cross-sectional area is the total applied load in pounds divided by the cross-sectional area in square inches.

Chicago Specifications

The following specifications, which apply to concrete used in manhole and catch basin block for the city of Chicago will be of interest. They are extracted from "Specifications for the Materials and Construction of Sewers," page 19, No. 57, by the Board of Local Improvements of Chicago.

"The fine aggregate used in all concrete in reinforced concrete sewers and in manholes and catch basins shall be of the best quality of torpedo sand, free from organic matter, and shall be graded in size so that not less than ninety-five per centum (95) can pass through a sieve having four (4) meshes to the lineal inch and not more than five (5) per centum can pass through a sieve having one hundred (100) meshes to the lineal inch and so that not more than twenty-five (25) per centum of said fine aggregate can pass through a sieve having fifty (50) meshes to the lineal inch. The coarse aggregate used in all concrete in reinforced concrete sewers and in manholes and catch basins shall be stone or gravel, free from dirt and impurities and shall be uniformly graded in size so as to pass through a ring of one (1) inch in diameter and be retained on a sieve having four (4) meshes to the lineal inch. All concrete used in reinforced concrete sewers and in manholes and catch basins shall be composed of one (1) volume of fine aggregate and two (2) volumes of coarse aggregate and such quantity of portland cement that four and one-half ($4\frac{1}{2}$) cubic feet of concrete in place shall contain ninety-four (94) pounds of cement. The concrete shall be thoroughly mixed with just sufficient water to form a plastic mass and shall be placed in forms before it has time to set."

Design and Construction

A concrete slab footing which also serves as a floor, provides the best base on which to build up the manhole or catch basin. Where the soil is soft or unstable a concrete base should be used in order to increase the bearing area. Manhole floors of concrete are sloped to prevent detention of sewage when the sewers are running over half full. In the case of manholes for other than sewer purposes the concrete floor is sloped in a small sump or trough at one end, from which small accumulations of seepage water may be pumped.

In Chicago and vicinity where the subsoil is heavy clay, it is standard practice to lay a 2-inch plank floor, which provides a level base for the first course of block. While the plank floor is not considered as good as a substantial concrete base, the former type is a little easier to place and requires less time. A template is conveniently used to maintain a true circle as succeeding courses are laid.

Special block containing openings of proper size to receive intake and outlet pipes, conduits, etc., are usually provided in order to expedite construction. However, these openings as well as irregular breaks and "run-arounds" frequently encountered in crowded pipe and

conduit lanes of city streets, are easily taken care of by cutting the blocks as required. The perpendicular walls frequently continue up about 4 feet, which would require 8 courses of block $5\frac{3}{4}$ inches high or 6 courses of block $7\frac{3}{4}$ inches high. It is then customary to "draw in" the circumference to an inside diameter of 24 inches, which takes the standard cast iron manhole cover as well as the standard concrete cover used in residential catch basin work.

Where block $5\frac{3}{4}$ inches high are used for the perpen-



A pile of manhole block ready for delivery

dicular portion, they are also used for the tapering neck. Where $7\frac{3}{4}$ -inch block are used for the perpendicular portion, tapered block, made in steel or wooden molds are employed for the neck. With block 18 inches long, 4 courses of these tapered block are required for 48-inch diameter manholes, 3 courses for 42-inch diameter and 2 courses for 36-inch diameter. No great irregularity of course levels should be permitted at any point in the perpendicular construction but should irregularly occur, it



The block piled at the side of the street, ready for use

must be rectified before the tapering courses are reached. The final course must be absolutely level to receive the cast iron or concrete cover ring.

The block, being placed below grade, should be laid moderately damp, using 1:3 cement and sand mortar containing 10 per cent hydrated lime by volume. All joints should be filled completely and trowelled off flush. While manholes and catch basins finished in this manner have proven fully as satisfactory in practice as any other type, and many engineers consider further expense on them entirely unwarranted, the application of mortar or brush coats may be found well worth while as precautionary measures where the construction is placed under unfavorable conditions.

For the exterior surface a thin, trowelled coat of 1:3 cement and sand mortar is recommended and for the interior a 1:1 cement and sand brush coat. Should a smoother interior be desired, it may be obtained by applying a trowelled coat similar in all respects to that applied to the exterior.

Economic Advantages

Concrete block construction of the best quality can be provided usually at a cost comparable to that of cheaper brick. Of course, one of the determining factors is the saving of labor effected by the use of a block; as each concrete unit takes the place of six to twelve brick. Due to the rectangular shape of brick, radial construction commonly employed for catch basins is slow and difficult. The convenience of concrete block for work of this kind is appreciated by the workmen. The greater weight of the units

is little noticed as there is a minimum of carrying and lifting in construction of this kind which is generally carried on at or below the ground level. For manholes of ordinary size only 45 to 60 blocks are used for the entire job. An ordinary street catch basin is completed in one-half hour to an hour and a half, as against two-thirds to three-quarters of a day used by a mason and helper laying a brick catch-basin of the same size.

Leading manufacturers of concrete block and brick machinery are now offering recently developed machines for making these units. There are also attachments by means of which these units can be made on wall block and brick machines. Over two million manhole and catch basin block were used in Chicago and its suburbs during the last year, and around three and one-half million during the last two years. The demand is developing rapidly in other parts of the country as well, due to the several inherent advantages of the construction and the obvious economies effected by its use.

Products Co-operative Association For Milwaukee

Concrete products makers of the city of Milwaukee, Wisconsin, have formed the Milwaukee Concrete Products Co-operative Association, and employed Benjamin Jelinek as secretary, with offices at 1100 Trust Company Building, Milwaukee.

This association is organized under the co-operative act of Wisconsin and it is the intention of the organization to do co-operative promotion work.

Washington Completes Longest Span in State

The completion of the Tacoma bridge marks the erection of the longest single span in the state of Washington and one of the most important units of the new section of the Pacific Highway between Tacoma and Marysville, Washington. The huge structure spans the Puyallup River at the southeast limits of Tacoma and eliminates four major railroad crossings. The new highway when completed in its entirety will shorten the distance between the cities mentioned 18½ miles, the distance now being

84 miles.

The total length of the structure is 2,833 feet and the width of the roadway between the curbs is 36 feet, with a five-foot sidewalk on either side.

Excavation amounted to 9,000 cubic yards. 92,894 lineal feet of piling and 15,042 cubic yards of concrete were put into use.

A saving of \$6,000 below the contract price of \$664,910 was made.



15,042 cubic yards of concrete were placed in building this bridge on the Pacific Highway between Tacoma and Marysville, Wash.

Convention of National Concrete Products Association

Merchandising and Advertising Problems of the Concrete Products Manufacturer Were Keynote of Discussions

The two high spots of the convention of the National Concrete Products Association held at the Palmer House in Chicago on February 22nd and 23rd, were the presentation of a code of ethics for the concrete products industry by Mr. Austin Crabbs of the Cement Products Company of Davenport, Iowa, and the paper, "Association Advertising as a Sales Asset," by Austin F. Bement of the Austin F. Bement Company, Incorporated, of Detroit, Michigan.

The Code of Ethics proposed by Mr. Crabbs was a well thought out set of standards to be observed by concrete products manufacturers in their various relations with employees, with sources of supply, with the public, and with each other. The spirit of the code proposed by Mr. Crabbs was that of clean, honest, and fair practices in all business relations—the spirit of co-operation as opposed to that of competition within the industry.

Mr. Crabbs' plea for this code was very well received by the convention. After he had finished his presentation of it a motion was made and carried to adopt the Code proposed as a tentative Code of Ethics for the association, and to place it in the hands of a committee for consideration during the coming year. It will in all probability be reported to the 1928 convention, either in its present form or in a revised form, for adoption as a permanent Code of Ethics for the association.

Mr. Bement's paper, "Association Advertising as a Sales Asset," pointed out in a very clear manner the necessity for a definite program which is facing the concrete products industry. He showed how other industries have met similar situations and solved them through the means of co-operative merchandising efforts and advertising.

The point that was very clearly made in Mr. Bement's paper was that the real competitor of the block maker is not his fellow block maker, but the manufacturer of other building materials. These manufacturers of other building materials in nearly every instance have grouped themselves to promote their own particular material, and are work-

ing to that end by the use of national advertising and co-operative sales efforts. In Mr. Bement's opinion, a similar co-operative program would be necessary for the concrete products industry if they expected to continue to make in the future the strides which they have in the past made in competition with other building materials.

Mr. Chandler pointed out how very necessary it was that concrete block be sold for above grade use if the growth of the industry was to continue, and gave his opinion that this could only be accomplished through national advertising on the part of the industry, and cement manufacturers. He pointed out what the Lehigh Cement Company had done in this matter to further the sale of concrete products by advertising which was creating a demand for block for purposes commonly served by other building materials.

This emphasis on the merchandising aspects of the industry was characteristic of the entire convention. The first paper presented was one by Mr. Gebhart of the Portland Cement Association entitled, "The Merchandising Viewpoint of the Florida Disaster." Much of the material given in Mr. Gebhart's paper was similar to that which has been presented in previous issues of CONCRETE. The most significant point of the whole thing was the way in which he viewed the situation from a merchandising standpoint, rather than from an engineering standpoint.

The first day of the convention closed with a banquet which was better attended than any previous banquet of the association, about 150 members being there. The second day of the convention was in co-operation with the American Concrete Institute, and the papers presented at that joint meeting are covered in the review of the Institute proceedings which is to be found elsewhere in this issue.

Mr. Sid Crew of Ohio was elected president for 1928 at the meeting of the directors which followed the sessions of the convention.



Building a Two-Level Street in Downtown Chicago

A Description of the Design and Construction Features of Wacker Drive—An Unusual Concrete Construction Job

By R. O. BENSON

Bureau of Design, Board of Local Improvements, Chicago

Part II—Design Features

Part I of this series of articles describing the design and construction features of Chicago's Wacker Drive, one of the largest single civic projects ever undertaken, was published in the January issue of "Concrete." It describes the methods used in designing and controlling the quality of the concrete placed in the structure.

Work of this magnitude and embracing so many unusual problems required a degree of initiative and boldness in design, seldom encountered. In this article the design features of this project will be described.

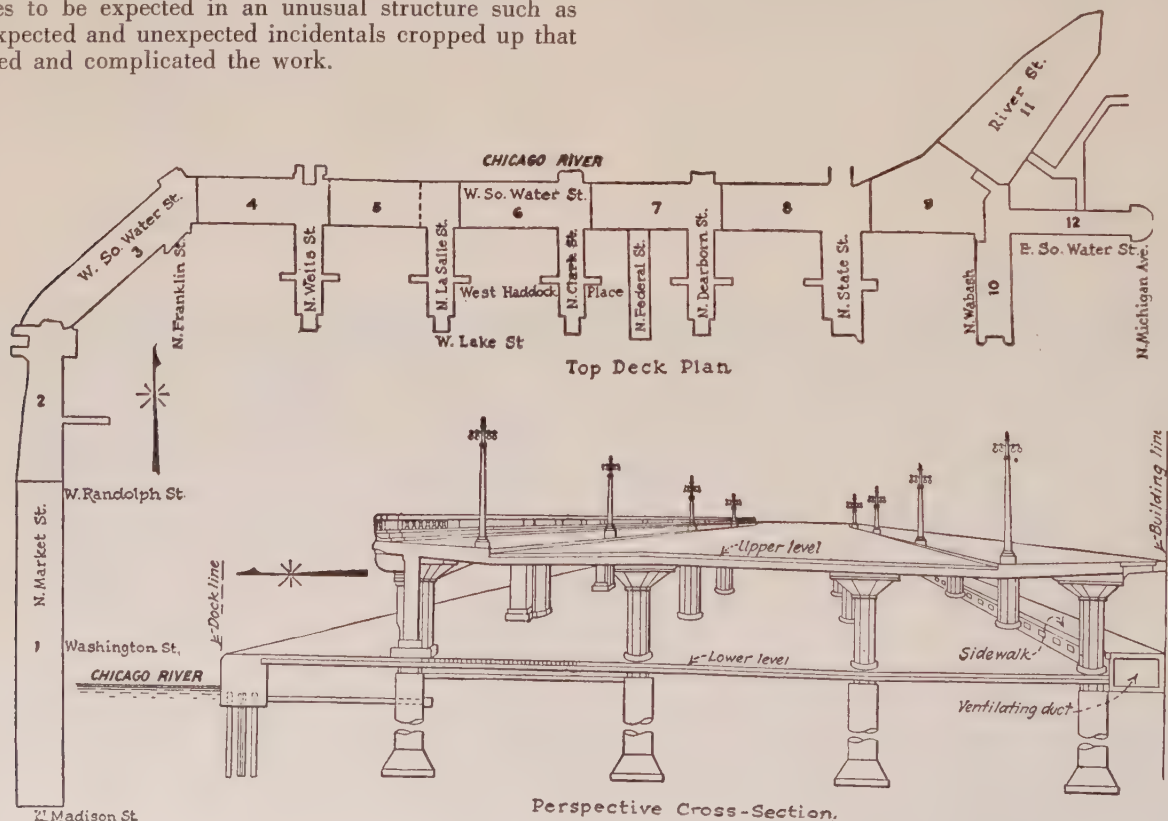
There were, for instance, the problems incident to maintaining traffic on the elevated and surface railroad crossings at two intersections. It was necessary to design a new elevated structure, provide for falsework to support the existing structure and design permanent foundations for both. The maintenance of street car and elevated railway traffic during construction necessitated the design of a temporary shallow type of through girder span that would permit excavation of the site and also permit the placing of the concrete.

General Design Features

The upper level of the roadway portion is reinforced concrete of the four-way flat slab type, supported by octagonal columns resting on cylindrical piers. In a few instances slab and beam construction was used where traffic conditions required spans up to 55 feet in length or where ornamental decorations imposed extraordinarily heavy concentrated loads.

There are wide sidewalks on the south side of the drive, varying in width from 12 to 24 feet. On the northerly

THE general plan and extent of the Wacker Drive improvement is shown in the illustration on this page. Because of the many overhead and underground obstructions met with exceptionally interesting design problems were encountered. In addition to the difficult design features to be expected in an unusual structure such as this, expected and unexpected incidentals cropped up that modified and complicated the work.



General plan and perspective of the Wacker Drive improvement, the design features of which are described in this article

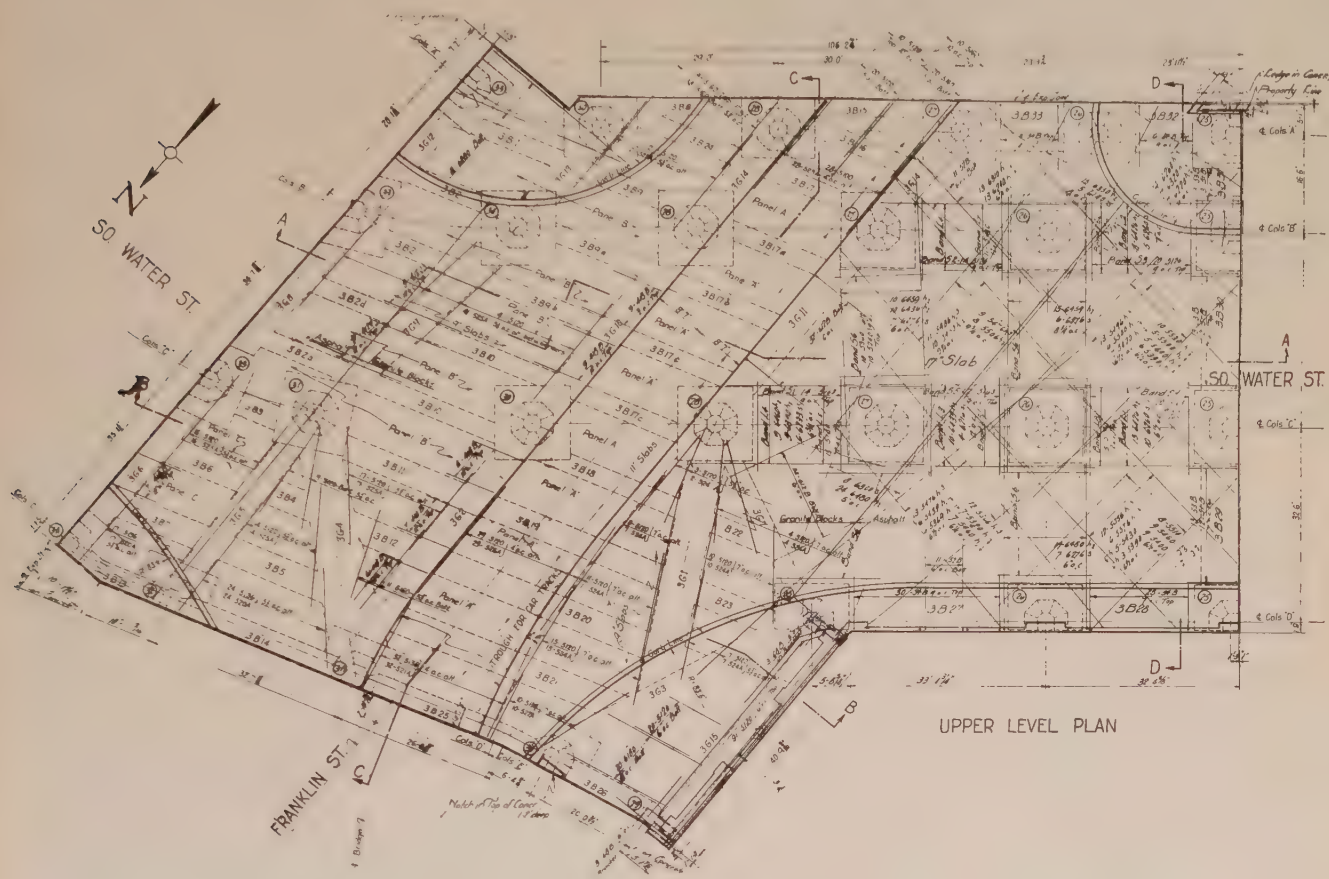
or river side there is a spacious promenade, providing a view of the river. The roadway varies in width, having a minimum capacity of 4 lanes of travel in each direction.

The lower level is excavated and depressed 9 feet below the level of adjacent streets and 5 feet above the river level. The lower level roadway consists of 3 bays, having a minimum headroom of 12 feet 4 inches. Two of the bays are used for through traffic. The third, along the building line, is reserved for vehicles that handle freight to and from the buildings along the drive. An elevated walkway,

saturated earth pressure, because of the exposure of one face of the pier by excavation (3) other lateral forces to which the piers might be subjected.

Longitudinal reinforcement was sufficient in most cases, except in some piers where a combination of spiral and longitudinal reinforcing were used to resist eccentric loads and lateral forces.

The "bug-bear" of the entire foundation work was the street intersections. Here the unforeseen elements soon made themselves evident. Aside from taking care of the



The reinforcing plan of the upper level intersection at Franklin and South Water Streets

three feet above the roadway, serves as both a ventilating duct and a loading platform. The uncovered portion of the lower level serves as dock space.

Dock

The dock wall is a concrete beam approximately 7 feet square. It is supported on 2 rows of piles between which is a row of Wakefield sheeting. The earth pressure is resisted by 2-inch rods on 11 feet centers, held in place by anchor beams placed back of the first row of caissons. The dock is entirely separated from the superstructure by a continuous mastic joint between the dock beam and the dock floor. Anchor beams are entirely separated from the caissons to prevent any shock from tugs or boats being transmitted to the superstructure.

Foundations

The entire upper level roadway sidewalks are supported on reinforced concrete piers or caissons. These piers are long shafts of concrete, cylindrical in shape, with "pier head" spread bases.

In general, all cylindrical piers were designed to resist the following vertical and horizontal forces.

(1) The dead load and 75 per cent of the live load of the superstructure that came to the columns, (2) the

many utilities that laced the intersections and providing the necessary false work to maintain street car, elevated and pedestrian traffic, provisions had to be made for the possibility of future subways.

Huge Foundation Girders

Between intersections, the average span of columns was 32 feet 6 inches. At street intersections a clear span of 44 feet was necessary for future subway construction. To provide for this contingency, the future subway locations were spanned by huge foundation girders, having a span of about 52 feet. The average size of these girders is about 5 feet wide by 9 feet deep.

At the LaSalle Street intersection, it was necessary to make provision for the existing street railway tunnel as well as for future subways. Here a girder with a 63 feet 7½-inch span, 6 feet by 12 feet in section was required. This girder was unique in that it had to be framed with forms that spanned the width of the girder and the entire structure was suspended from 12 by 12-inch timbers that rested on mud sills.

The foundation girders were designed as a beam supported on cylindrical piers at each end. There was a concentrated load in the center of the girder and 2 exterior concentrated loads overhanging the supports.

Columns

The columns were designed according to the requirements of the Chicago Building Code. The viaduct was considered as a rigid frame, the columns being fixed at the base. Typical viaduct frames consisted of 3 cross frames and 5 spans between expansion joints. Two problems were presented. (1) the stresses caused in the frame as seen in longitudinal elevation and (2) the stresses in the cross frames as seen in a transverse section of the structure.

The columns were designed to withstand (1) the dead load of the frame, (2) the vertical live load on alternate panels plus 50 per cent impact, (3) stresses due to changes in temperature up to 60 degrees.

The slope deflection method of analysis developed with the aid of the principle of area moments as outlined in Hool and Johnson's Structural Engineer's Handbook was used. The method of finding the stresses in the columns was that as outlined in Hool and Kinne's Structural Members and Connections.

Analysis by this method brought out the fact that the elevations at the bases of the columns should follow the curve of a parabola, the vertex being midway between expansion joints. The stiffness of the columns made it necessary to increase their length. Allowing for drop panels and capitals, the length of the columns left a shaft of only 8 feet. Expansion of the 150-foot slab causes a movement of approximately $\frac{3}{8}$ inch at the top of the column. A

32-inch column, 8 feet long cannot be designed to take the bending that would result from such a movement. Accordingly, the design fixed the tops of the caissons at such an elevation that column lengths were increased to 26 feet. The space between the concrete columns and between the columns and the pavement was filled with mastic to permit movement at the surface of the lower level pavement.

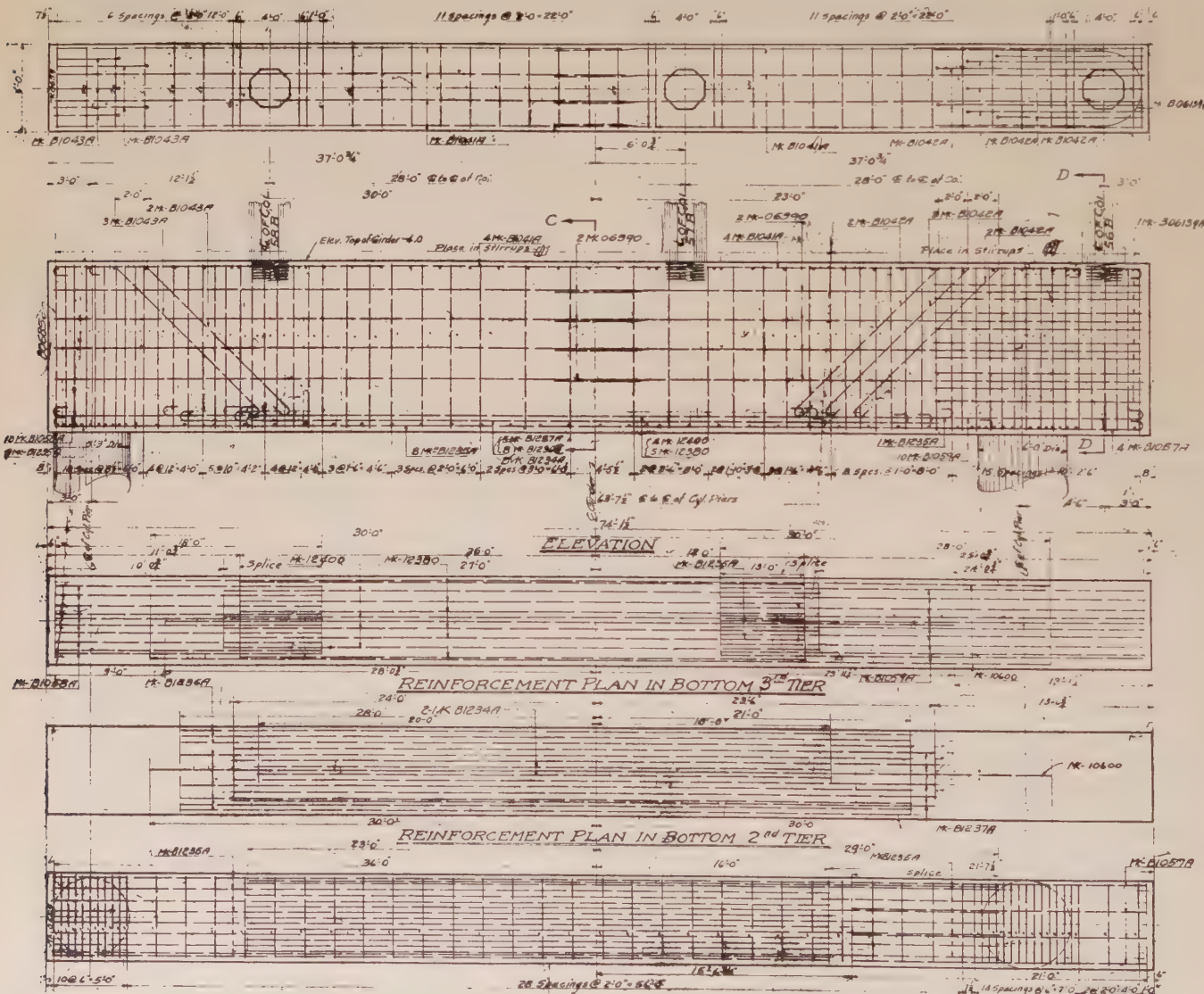
The columns were poured in two operations, first the shafts then the capitals.

Slabs

Four-way, reinforced concrete slabs supported on columns, with column heads and column plates were used to support the upper level roadway. This type was used because of its adaptability to this particular kind of structure. It was also very economical, eliminating all beams and girders whatever, and permitting uniform lighting of the lower level.

A typical panel 32 feet 6 inches square was maintained wherever possible. On an irregular structure, it was of course, necessary in some instances to vary the sizes of the panels, the maximum panel being 37 feet by 44 feet.

According to the specifications for viaducts laid down by the Bureau of Engineering, City of Chicago, the standard panels required a 17-inch slab. It was desirable to maintain this panel thickness for all slabs, either larger or smaller than the standard. This was done, in the case



One of the large foundation girders. It is 74 feet long, 12 feet deep and 6 feet wide

of the larger panels, by increasing the depth of the drop panels to keep the shear within the requirements. It was also necessary to increase the steel for negative moments at the column heads.

Investigations by the slope deflection method showed that it was necessary to increase the coefficients for negative moments about 15 per cent to take care of any stresses in the slabs due to the movements of the columns. For the same reason, column bars were bent at right angles and run out into the slab below the top surface.

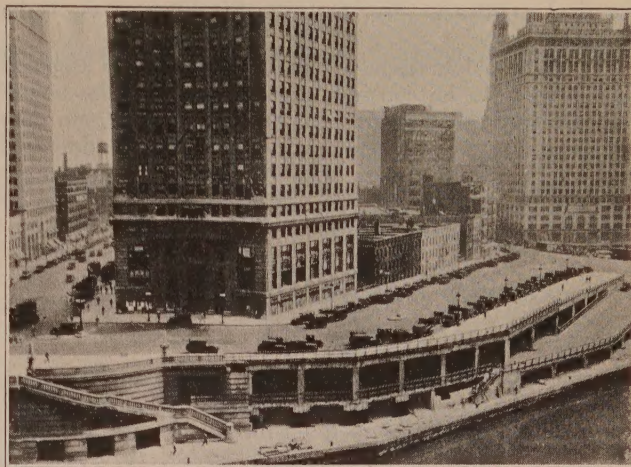
Stresses due to temperature changes were taken care of by the addition of reinforcing steel in the top and bottom of the slab.

At street intersections, an additional problem was presented by the need of carrying street car tracks up and over the viaduct. A trough 11 inches deep was made in the slab to meet this condition. It was necessary to derive new unit loads to solve the design problems introduced.

Due to the spacing of the columns to provide the proper roadway and sidewalk space on the lower level, the south portion of the upper level had to be carried as a cantilever. At street intersections the cantilever became about $12\frac{1}{2}$ feet from center of columns.

A portion of the viaduct between State Street and Wabash Avenue was designed for loads greatly in excess of those on the rest of the structure. For this reason and

traffic as well as by trucks handling freight to and from the adjacent buildings, provision for artificial ventilation was necessary. The system was divided into 3 sections each with its fan. Each of the fans will have a capacity of



Where Wacker Drive joins Michigan Avenue, showing the architectural treatment on the river side

230,000 cu. ft. per minute which provides for 6 complete changes of air per hour.

Architecture

A notable feature of the improvement is the architectural treatment along the river face.

The stretch between State and Franklin Streets, comprising 5 blocks has a facade consisting of a series of concrete arches, elliptical in form and surmounted with a continuous belt course and balustrade of Bedford stone. The piers or pilasters forming the supports for the arches are also of concrete, having granite for their bases and Bedford stone corbel block forming the caps of the piers. Other beautiful ornamentation gives the viaduct the air of distinction that a structure of this kind merits.

Conclusion

The entire work has executed under the direct supervision of the late John J. Sloan, President of the Board of Local Improvements.

The planning was completely finished in the Bureau of Design, Board of Local Improvements.

T. A. Evans was in charge as Chief Engineer with Arthur Engh as principal assistant and R. O. Benson in charge of designing in the office.

(Part III of this series, to be published in an early issue, will describe the unusual construction features encountered in the building of Wacker Drive.)

Supertile Patents Become Property of MacGlashan Corporation

The MacGlashan Corporation, Tecumseh, Michigan, with its associated companies, H. Brewer and Company, and the Republic Iron Works, a subsidiary, has taken over control of all Supertile patents by absorbing the business of the Supertile Machinery Corporation.

Considerable headway had been made by the Supertile Machinery Corporation in establishing plants on the Pacific coast, before being absorbed by the MacGlashan Corporation. Stephen Flam, inventor of Supertile machinery, has been engaged as production manager. He will be able to offer experienced and authoritative supervision of all production details.

The special Supertile equipment is manufactured in the Brewer and Republic plants at Tecumseh, Michigan.



One of the approaches to the new two-level drive

also because of the longer spans involved, beam and girder construction was used for this portion. The irregularity of some of these panels introduced some very interesting design problems.

Expansion joints between Lake and State Streets are about 145 feet apart. East of State Street, the distances between expansion joints were irregular, reaching 204 feet in one instance.

Vent Duct

A combined reinforced concrete elevated sidewalk and loading platform was constructed on the lower level adjacent to the southerly building line. This box like structure also serves as an air duct for the ventilating system.

As the lower level will be used largely by transit truck

A. C. I. Convention

(Conclusion)

sented by Norman M. Stineman and Roy L. Peck. They described conditions after both the Florida and the Cuba hurricanes.

One of the points discussed was the question of assumed wind stresses to be considered in design and the actual wind pressure on structures during the storm. From data now available, it was estimated that buildings designed for a lateral wind pressure of 25 or 30 pounds per square foot will have sufficient reserve strength to withstand storms of the violence of these two hurricanes.

Thursday Morning—Research

Natural Stone as Aggregate

In his paper, "Qualifications of Different Kinds of Natural Stone for Concrete Aggregates," G. F. Loughlin of Washington, D. C., pointed out the importance of aggregates in preserving or destroying concrete. He discussed in detail the various classes of aggregates available and analyzed the good and bad points of each. He explained that the type of aggregate selected has a very definite influence on the durability of the resulting concrete and that poor aggregates, that are subject to corrosion, are not apt to be permanent.

In discussing this paper, attention was called to the fact that corrosion of concrete was apt to occur when an aggregate that contained a preponderance of negative ions was used.

Cement in Concrete Engineering

This paper, delivered by Dr. R. H. Bogue, Research Director of the Portland Cement Association Fellowship at the U. S. Bureau of Standards, is published in full on other pages in this issue.

Researches on Concrete Materials

The report of Committee E-3 presented by Chairman H. F. Gonneman, outlined the principal researches carried out in the United States and Canada during 1926 on concrete material and on plain and reinforced concrete. It also included a list of suggested researches. An important feature of the report is a list of the outstanding papers and reports on these subjects published during 1926 in the United States and foreign countries.

Coarse Aggregate

Herbert J. Gilkey, Associate Professor of Civil Engineering at the University of Colorado, presented a paper entitled, "The Coarse Aggregate in Concrete as a Field for Needed Research," in which he described a series of tests made with a view to comparing the strength of mortars and concretes which were identical except for the presence or absence of coarse aggregate.

Test for Workability

Professor Tokujiro Yoshida, of the Kyushu Imperial University, Japan, pointed out in detail the various difficulties in the many methods already in use for determining workability and suggested as a new and better method the diameter of the spread of concrete formed when dropped in a standardized manner from a bowl similar in size and dimensions to the bowl used in flow table tests. Professor Yoshida has worked out a practical apparatus for making this determination and he uses as his index of workability the ratio of the resulting diameter of the mass of concrete dropped to the original diameter of the mass in the bowl.

Thursday Afternoon and Evening—Time as a Factor in Making Concrete

The two last sessions of the Institute centered around the theme, "Time as a Factor in Making Concrete." Seven papers, covering the various phases of this subject were presented.

In the Study and Use of Cement

P. H. Bates of the U. S. Bureau of Standards opened the subject with his paper, "Why Time Is a Factor in the Study and Use of Cement." He told of the studies made at the Bureau of Standards on the effect of excess water on concrete to determine whether the excess water weakened the concrete when it was removed before certain changes had taken place. Specimens varying in age from 7 days to 5 years were studied.

The tests showed that at early ages the excess water did weaken the concrete but at 5 years the difference in strength due to excess water had disappeared. Specimens in which the excess water was removed in 3 hours showed strengths that compared favorably with the strengths of specimens made without excess water.

Duff A. Abrams continued the discussion of the subject, by considering the water-cement ratio theory from the time point of view.

As a Factor in Pavement Construction

T. H. Johnson of Sioux City, Ia., showed the application of time to concrete pavement construction methods. He related his experiences in taking excess water out of concrete pavements at a definite time after mixing. He recognized the importance of the time factor in determining the water-cement ratio at the period when the concrete is on the subgrade and has begun to develop strength.

In Stucco

The evening session continued the discussion of this theme with a paper by John J. Earley, architectural sculptor of Washington, D. C. Mr. Earley's contention was that it was not so important to keep the water content in concrete down during the time that the concrete is being mixed and placed provided that this excess water is removed within a reasonable time after the concrete is mixed. It is this principle that Mr. Earley has used on many of his well-known successful jobs.

In Cast Stone

W. Paul Eddy of the Onondaga Litholite Company of Syracuse, N. Y., showed the application of this theory to the manufacturer of wet-cast stone. By placing the wet concrete in sand moulds, the excess water is absorbed by the sand and the water-cement ratio of the concrete in the moulds determines the strength of the hardened concrete stone.

In Pipe Manufacture

In the manufacture of concrete pipe by the centrifugal process, the soupy mixture is put into the cylinder of the machine. The centrifugal action as the mould revolves, removes the excess water and the concrete is of a dry consistency when it begins to harden.

In Dry Tamp Products

In the dry tamp process, also, it is found that time is a factor in the quality of the finished product. George Chandler of the Superior Products Co., Detroit, discussed the relation of the time factor in the manufacture of dry tamp products.

With the Manufacturers

Industrial Literature

Monorail Catalog

The new Louden Overhead Monorail Catalog No. 8, issued by the Louden Machinery Company, Fairfield, Iowa. Contains 56 pages of engineering details, data, etc., so complete that an entire system may be worked out for any given conditions. A feature of this catalog is the section showing blue prints of typical installations.

Spiral Reinforcing Sizes

Elimination of waste in steel spiral reinforcing rods is recommended by the U. S. Department of Commerce in its *Simplified Practice Recommendation No. 53*. The action reduces the number of sizes from 7 to 4, and is covered in a report by National Committee on Metals Utilization, and approved by Secretary of Commerce Herbert Hoover.

For Pipe Manufacturers-Elect

The McCracken Machinery Company, Sioux City, Iowa, pipe machine manufacturers, in a 24-page catalog, entitled, "McCracken Concrete Pipe Machinery," tell of the universal use made of their machinery. Operation, plant layout and curing yards and rooms in foreign and domestic plants are pictured and described.

Workability Booklet

How to get concrete down the chute without segregation or excess water is told by the Celite Products Company in a folder showing current Chicago work. The text is abbreviated and the photographs show details well.

Reinforcement Products

A conducted tour through any of the Concrete Steel Company shops and warehouses is embodied in a new 40-page book featuring Havemeyer bars and building products. Views of the numerous warehouses and descriptions and illustrations of its 150-odd products related to concrete road and building construction form the contents.

An entire eight-page booklet is devoted to the Havemeyer truss, also a product of the Concrete Steel Company.

Overhead Conveying

Handling material in process is the subject of a new four-page folder published by the Cleveland Electric Tramrail Division of the Cleveland Crane and Engineering Company, Wickliffe, Ohio. Photographs show how engineers have fit the moving to the making in different types of plants.

Welding Catalog

Catalog 172-E published by the Alexander Milburn Company, Baltimore, Maryland, is a comprehensive edition in vest-pocket form. It covers welding rods, acetylene generators, paint guns and sprays, etc., and may be secured upon request.

Notes from the Field

New Rope Plant

With the purchase of the Joseph Cochran interests in the Williamsport Wire Rope Company of Williamsport, Pa., by a syndicate headed by Robert Gilmore, the control of this company virtually passes into the hands of old employees, who have put into immediate action the building of a wire rope plant in the city mentioned.

Robert Gilmore, president, continues as the directing head, Edgar Munson becomes vice-president and treasurer, Logan Cunningham will be the vice-president and secretary, and Mr. C. M. Ballard, vice-president and general sales manager.

New Sales Manager

Blaw-Knox Company announces the appointment of John C. White, president of the Arrowhead Iron Works of Pennsylvania, Inc., as Sales Manager of the Steel Grating and Flooring Department. Mr. White will be located at the general offices at Pittsburgh.

Kent Office in Chicago

The Conveying Machinery Division of the Kent Machine Company, Kent, Ohio, announces the opening of a Chicago office at 625 Monadnock Block, with Mr. F. E. Schwalb as manager and sales engineer.

Mr. Schwalb was previously Chief Engineer of the Weller Manufacturing Company.

Mixer Standardization

The Boss Mixer and Hoist Catalog No. GC-27, just distributed to the trade by the American Cement Machine Company, Keokuk, Iowa, presents a step forward in the standardization of mixers and hoists. The speed of the mixing and discharge action of the mixer allows the user sufficient capacity to employ, in many cases, a smaller-size machine.

Lime Booklet

"Watertight Concrete," Bulletin 301, just issued by the National Lime Association, Washington, D. C., is an attractively covered and well illustrated discussion of the value of hydrated lime in concrete. The text is based upon actual experience, supplemented by laboratory data.

Western Manager

Mr. M. B. Urquhart has assumed the Western Management of the Philadelphia Grease Mfg. Co., Philadelphia, Pa., with offices and warehouses located in the Ideal Building, Denver, Colorado and 144 South Fifth West St., Salt Lake City, Utah.

Mr. Urquhart, who has been Northwestern manager for the Keystone Lubricating Co., Philadelphia, for the past twenty years, recently resigned from the position.

Contractors' Equipment

The Heltzel Steel Form & Iron Company, Warren, Ohio, now have ready for distribution a 32-page catalogue covering some twenty different pieces of contractors' equipment. It contains information of value to building contractors as well as to those contractors building roads, streets and sidewalks.

Heil Representative

Mr. R. C. Schultz, who has been connected with the Heil Co. branch in Chicago, has been appointed Cleveland representative for the Heil Co. with headquarters at the Gustav Schaefer Wagon Co., 4180 Lorain Avenue, Cleveland. A stock of hoists, bodies and service parts is available for the Cleveland territory and immediate service is offered for users of Heil equipment in that territory.

Mixer Musings

Reported by "Joe"—The Mixer Boss.

Slump Testers, Attention!

THROUGHOUT the length and breadth of the land, Slump Testers have been applying their highly specialized knowledge. For years, with pails, rubber cylinders, wooden boxes, cast-off tin cans and other more modern equipment they have labored and perspired over their exacting tasks.

And what has been their reward? Alas, not much. The members of this honorable profession of Slump Testers, like those of many other noble and worthy professions requiring delicate skill and rare judgment, have gloried in their task, asking neither recognition nor honor.

But enough is too much. The time has arrived at last when it is deemed expedient to accord this honorable profession the honor that it rightfully deserves and to collect and record the thrilling experiences of those Slump Testers who have helped to place the profession on the high pedestal that it should, and will, occupy.

How is this to be done, you ask? Ah, very simply. Through organization, of course.

Now, therefore, I, Joe, the Mixer Boss, propose that all true and worthy Slump Testers organize themselves into a **Guild** to the end that all may know of the great work that is silently but earnestly going on in products plants, on construction jobs, in laboratories and everywhere better concrete is being made.

A GREAT work needs to be done! Through years of development, the slump test has passed through periods of vicissitude and prosperity. Legends have sprung up around this noble task. Implements and methods, now passed into dark oblivion have contributed to its upbuilding. Shall these be forgotten? Or shall they be appropriately recorded and preserved for posterity? The answer must be "yes."

The Guild of Certified Slump Testers is, therefore, here declared to be organized and operative. All good and true Slump Testers, even though they have made only one slump test in the course of their natural lives, are eligible for membership.

All that is required is that every Tester, aspiring to the honor of membership in the **Guild**, write to Joe, the Mixer Boss, 21st floor, 139 North Clark St., Chicago, and recount his experiences in making his first slump test. If, in the opinion of the Committee on Members, this document has the ring of sincerity, and the Committee is satisfied that the applicant appreciates the honor about to be bestowed upon him it (the Committee on Members), will admit said applicant to membership in the **Guild of Certified Slump Testers** and send him a beautiful, impressive certificate, conferring upon him the *Degree of Certified Slump Tester*, together with all the rights, privileges and immunities thereto appertaining.

Applications for membership will be received at the office of the Keeper of the Records immediately after the publication of this announcement.

All loyal true Slump Testers are urged to perform their share of the duties incident to the organization and administration of this urgently needed **Guild**.

One thing can be said of it that will not be open to dispute—the organization does not mean much, but *it is exclusive*.

Joe, the Mixer Boss.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 West Thirty-ninth St., New York City.

American Road Builders' Association; Wm. H. Connell, President, Miss E. A. Birchland, Secretary, 29 W. 39th St., New York City.

American Society for Testing Materials, C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; 123 West Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference; H. E. Plummer, President, J. F. Downey, City Hall, Cambridge, Mass., Secretary.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago. Third annual meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., March 21-23.

Concrete Products Association; S. I. Crew, Cincinnati, Ohio; D. R. Collins, Secretary, 47th and State Streets, Alois Postoffice, Milwaukee, Wis.

Concrete Products Association of Greater Boston; Glenn T. Hoyt, Secretary, 80 Whitman Ave., Melrose, Massachusetts.

Iowa Concrete Products Association; H. E. Meier, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President, 37th St. & Stewart Ave., Chicago. A. W. Dickson, Executive Secretary, 214 Electric Bldg., Cleveland, Ohio.

National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 East Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East Twenty-second St., New York City.

The National Lime Association; Burton A. Ford, Secretary, 927 15th Street, N. W., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

National Sand and Gravel Association, V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

Nebraska Concrete Products Association; A. V. Anderson, President, Reimers-Kaufman Co., Lincoln, Neb.; E. L. Bateman, Secretary, Bethany, Neb.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Wisconsin Concrete Products Association; A. P. Kuranz, Secretary-Treasurer, 425 E. Water St., Milwaukee.